DEPARTMENT OF HORTICULTURE

Annual Progress Report

209

1975-76

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PUNJAB AGRICULTURAL UNIVERSITY
LUDHIANA

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PUNJAB AGRICULTURAL UNIVERSITY
LUDHIANA—141004

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PUNJAB AGRICULTURAL UNIVERSITY
LUDHIANA—141004

The Department of Horticulture is responsible for teaching, extension education and research in horticulture in the Punjab. The department has a net-work of regional research stations located in different agro-climatic zones of the state to tackle the problems of fruit cultivation under a particular set of conditions. The regional research stations along with the main station at Ludhiana, have done commendable work to solve the problems of the fruit growers. An extensive collection of various fruit varieties and species is being maintained in the department for selection and hybridization work so that the fruit growers are given suitable varieties for cultivation.

The present report comprises the results obtained at the main station and the regional research stations of the Department of Horticulture for the year 1975-76. Dr. J.S. Jawanda, who compiled this report, deserves my special thanks for the effort he has put in to bring out this report. The help of Shri K.K. Sharma along with Dr. S. N. Singh in this project is also acknowledged. Thanks are also due to Shri Ved Parkash who typed the manuscript.

(G. S. NIJJAR)
Professor and Head
Department of Horticulture
Punjab Agricultural University
LUDHIANA

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INTRODUCTION

The Department of Horticulture carried out its teaching, research and extension education programmes with great zeal and enthusiasm.

The under-graduate compulsory courses, viz. Hort. 201 and Hort. 311 were offered to 200 and 88 students respectively. Postgraduate courses : Hort. 502, 503, 504, 505, 506, 508, 557, 591 and 602 were also taught. During the year, five fresh students in M.Sc. and four in Ph.D. programmes were admitted; whereas eight M.Sc. and five Ph.D. students submitted their theses.

The breeding and improvement work on peaches, almonds, plums and grapes has been intensified at Ludhiana. Performance of a large number of F_1 hybrids of grapes and almonds was evaluated. Citrus granulation has assumed serious proportions in the State especially the arid-irrigated regions. A detailed survey on the extent of granulation in the citrus orchards in different localities in the State has been completed. A virus-free citrus germplasm bank has been established at P A U, Ludhiana, where virus-free mother trees of 16 important citrus cultivars are being maintained in a large insect-proof screen house. Already, more than 3,500 virus-free buds and some 300 virus-free budlings and seedlings have been supplied to various research stations.

The Regional Fruit Research Station, Abohar continued to tackle vigorously the problems of citrus, grapes and dates, peculiar to the arid-irrigated region. Dr. M.S. Randhawa, Vice-Chancellor inspected this research station on 3rd February, 1976 and was very much impressed with the quality and quantum of research work and the excellent management of the

orchard. The citrus industry of the region particularly the new Kinnow Orchards in sizeable areas highly impressed him.

A team comprising of Dr. K.N. Satyapal, Senior Technical Advisor, UNDP, New York; Mr. Styrbjorn Alstrom, FAO/UNDP, New Delhi; accompanied by Dr. Sri Ram, Scientist, Indian Council of Agricultural Research visited the Regional Fruit Research Station, Abohar to see the date-palm and study the research work being done on that crop. Under UNDP/FAO project, the Abohar Station will be receiving some 2,000 off-shoots of promising cultivars of dates in the near future. A high level team consisting of Mrs. March, Joint Director and Mr. K.M. Mohli, Deputy Director of the Consultancy Cell of Ministry of Agriculture, Govt. of India; accompanied by Shri Bedi, Project Engineer of the Punjab Markfed visited the station on 28th and 29th January, 1976 to survey the area and to study the feasibility of establishing a citrus processing unit in Abohar area.

The Fruit Research Station, Bhatinda made excellent progress during the year. A number of field experiments of citrus, grapes, dates, peaches, plums, almonds, guava, etc. have since been planted in an area of about 70.0 acres. Dr. M.S. Randhawa, Vice-Chancellor laid the foundation stone of the Horticulture Laboratory Building at this station on February 2, 1976 which will cost Rs. 6.80 lakhs. He appreciated the good work done by the scientists of the Department of Horticulture, in transforming barren and uneven land into a first rate experimental orcha in a short period of only four years.

At the Fruit Research Station, Bahadurgarh (Patiala) field trials on ber, pear, plum and guava made good progress. The Ber Day organised at this station on March 22, 1976 was attended by a large number of growers from all over the State. Research on litchi and mang

continued to receive major attention at the Fruit Research Station, Gurdaspur. At the Fruit Research Station, Gangian, planting of various trials of mango, litchi, citrus, pear, peach and ber has been completed. An intensive survey was carried out to locate promising and meritorious seedling mango trees in the area. A comprehensive collection of seedling mango is being set up at this station.

The nursery production work was further intensified at all the research station and 1.33 lakh fruit plants of different kinds and cultivars were propagated during the year. Other extension education activities included holding of peach training-cum-pruning camps at Solan, Ludhiana and Gangian. An impressive Grape Field Day was organised at Ludhiana on June 22, 1976 when a large number of grape growers were taken around the University vineyards. The visitors were also shown grapes of promising varieties. Dr. M.S. Randhawa, Vice-Chancellor, Punjab Agricultural University, Ludhiana was the Chief-guest at this function.

**

S T A F F

Details of the staff working in the Department of Horticulture are given below :

Name	Designation	Place of posting	Remarks
T E A C H I N G			
Dr. G. S. Nijjar	Professor & Head	Ludhiana	
Dr. B. S. Dhillon	Professor of Horticulture	Ludhiana	
Dr. Satjit Singh Grewal	Associate Professor of Horticulture	Ludhiana	
Dr. J.S. Arora	Assistant Professor of Horticulture	Ludhiana	
Sh. I. S. Deol	Assistant Horticulturist	Ludhiana	
Sh. Gurpal Singh	Lecturer	Ludhiana	On study leave
Sh. Amrik Singh	Lecturer	Ludhiana	On study leave
Sh. Gurcharan Singh	Lecturer	Ludhiana	
R E S E A R C H			
Dr. J. S. Jawanda	Senior Horticulturist	Ludhiana	
Dr. M. S. Bajwa	Horticulturist	Abohar	On deputation with Afghanistan Govt. w.e.f.10.5.76
Dr. D. K. Uppal	Horticulturist	Ludhiana	On leave w.e.f. 1.11.75 to 31.10.78
Dr. A. S. Bindra	Horticulturist	Ludhiana	

Name	Designation	Place of posting	Remarks
Sh. Jagdyal Singh	Horticulturist	Bhatinda	
Dr. S. P. Kapoor	Plant Pathologist	Ludhiana	
Dr. Prem Singh	Horticulturist	Ludhiana	Expired on 17.3.76
Dr. G. S. Chohan	Horticulturist	Abohar	
Sh. R. S. Dhillon	Assistant Horticulturist	Ludhiana	
Dr. S. K. Choudhary	Assistant Horticulturist	Ludhiana	
Sh. M. P. Singh	Assistant Horticulturist	Ludhiana	
Dr. S. S. Mann	Assistant Horticulturist	Ludhiana	
Dr. H. N. Khajuria	Assistant Fruit Breeder	Ludhiana	
Sh. S. S. Cheema	Assistant Plant Pathologist	Ludhiana	
Dr. A. S. Dhatt	Assistant Fruit Breeder	Ludhiana	
Dr. J. S. Bhullar	Assistant Horticulturist	Ludhiana	
Sh. G. S. Bajwa	Assistant Horticulturist	Ludhiana	
Sh. J. S. Khangura	Assistant Entomologist	Ludhiana	
Sh. J. S. Kanwar	Assistant Horticulturist	Gangian	
Sh. Sohan Singh	Assistant Horticulturist	Gurdaspur	
Dr. M. R. Gupta	Assistant Horticulturist	Bahadurgarh (Patiala)	Resumed duties w.e.f. 15.10.7 after completion of Ph.D.
Sh. N. K. Mehrotra	Garden Superintendent	Abohar	On study leave
Sh. S. K. Kalra	Assistant Horticulturist	Abohar	
Sh. Raghbir Singh	Assistant Horticulturist	Abohar	On study leave
Sh. M. S. Mann	Assistant Soil Chemist	Bhatinda/ Abohar	
Dr. R. C. Sharma	Assistant Horticulturist	Bhatinda	
Sh. Harish Kumar	Garden Superintendent	Bhatinda	
Dr. S. N. Singh	Research Assistant	Ludhiana	Joined after completing Ph.D on 17.1.76

Name	Designation	Place of posting	Remarks
Sh. Room Singh	Research Assistant	Ludhiana	On study leave
Sh. R. P. S. Gill	Research Assistant	Ludhiana	
Sh. Yog Raj Chanana	Research Assistant	Ludhiana	
Sh. K. K. Sharma	Research Assistant	Ludhiana	
Sh. Sinderjit Singh Gill	Research Assistant	Ludhiana	
Mrs. Shashi Kapur	Research Assistant	Ludhiana	
Sh. Sukhdev Singh Brar	Research Assistant	Ludhiana	
Sh. Jasbir Singh Randhawa	Research Assistant	Ludhiana	
Sh. Ajit Singh	Research Assistant	Ludhiana	
Sh. Sudesh Kumar Kapur	Research Assistant	Ludhiana	
Sh. R. C. Batra	Research Assistant	Abohar	On study leave
Sh. J. N. Sharma	Research Assistant	Abohar	
Sh. V. K. Vij	Research Assistant	Abohar	
Sh. S. K. Munshi	Research Assistant	Abohar	
Sh. S. C. Sharma	Statistical Assistant	Ludhiana	
Sh. Pirthi Singh	Research Assistant	Bhatinda/Abohar	
Sh. N. S. Tomer	Research Assistant	Bhatinda	
Sh. Satish Kumar Thetai	Research Assistant	Bhatinda/Abohar	

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INCOME & EXPENDITURE

The details of budget, expenditure and income in respect of teaching and research schemes in the Department are given below :-

S.No.	Name of the scheme	Budget Allotment	Expenditure	Income
1-	Gurdaspur Gardon, NP-13	35,570.00	39,675.63	95,6[illegible]0.00
2-	Establishment of Regional Fruit Research Sub-station, Bahadurgarh (Patiala) NP-14	91,560.00	90,130.00	75,581.20
3-	Fruit Research Station, NP-16	3,13,600.00	3,10,348.54	25,003.18
4-	Establishment of Regional Fruit Research Station, Abohar, NP-17	4,50,600.00	4,46,599.69	2,08,777.5[illegible]
5-	Establishment of Fruit Research Station, Bhatinda, NPC-7	3,15,550.00	3,14,079.09	43,05[illegible]
6-	Expansion of Horticultural Research at Ludhiana Part-I, Leaf Analysis, Standard for fruit trees in Punjab, NP(C)-8	86,685.00	86,618.01	-
7-	Expansion of Horticultural Research at Ludhiana Part-II, Cold Storage of Fruits NP(C)-8	46,340.00	44,709.12	-
8-	Establishment of Fruit Research Station, Gangian, NPC-9	1,22,355.00	1,13,678.03	18,9[illegible].20
9-	Establishment of Fruit Nursery Production Work at Ludhiana NPC-10	66,680.00	65,199.07	25.152.14
10-	Intensification of Research Work on Litchi and Mango at Gurdaspur NP(C)-12	30,305.00	23,830.35	-
11-	Construction of Building at Horticultural Research Station Bhatinda	4,00,000.00	4,00,000.00	-
12-	Establishment of Fruit Plant Nursery at Bahadurgarh (Patiala) Revolving Fund Scheme-8	38,300.00	37,119.13	35,1[illegible]
13-	Establishment of Fruit Plant Nursery at Gangian (District Hoshiarpur), Revolving Fund Scheme No. 10	25,300.00	24,918.86	30,43[illegible]

S.No.	Name of the scheme	Budget Allotment	Expenditure	Income
13-	Establishment of Fruit Plant Nursery at Gurdaspur, Revolving Fund Scheme No. 9	33,400.00	20,222.39	30,093.00
	T E A C H I N G			
1-	Establishment of College of Agriculture, Ludhiana, NP-30	2,01,365.00	2,00,125.47	29,728.05
2-	Strengthening Facilities for the Development of Under-graduate/ Post-graduate studies at College of Agriculture, Ludhiana NP(C)-32	27,580.00	27,739.25	-
3-	Strengthening Facilities for the Development of College of Agriculture Plan-52	43,000.00	42,934.18	-
4-	Additional Facilities for the development of Postgraduate Studies, NP-40	13,500.00	13,517.02	-
	INDIAN COUNCIL OF AGRICULTURAL RESEARCH : SCHEMES			
1-	All India Coordinated Fruits Improvement (Part-B), Ludhiana Centre, Grapes, ICAR-33	31,600.00	38,025.85	-
2-	Investigation on the Flower and Bud Drop in Grapes, ICAR-34	48,600.00	45,702.78	-
3-	All India Coordinated Fruit Improvement Project - Citrus Fruits- Bhatinda, ICAR-35	81,300.00	52,414.79	-
4-	Coordinated scheme for certification, Inspection and Registration of virus free citrus tree at Ludhiana, ICAR-37	1,11,000.00	1,83,092.97	-
	Evolution of Almond, Peach and Plum varieties suitable for cultivation in the plains of Punjab, ICAR-36	64,600.00	58,841.74	-
	GRAND TOTAL.....	26,48,790.00		

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T E A C H I N G

The Department of Horticulture offered elective courses in Horticulture at the undergraduate level. The postgraduate programmes leading to M.Sc. and Ph.D. degrees were also offered.

The number of students in various programmes during 1975-76 were as under :-

Sr.No.	Class	No. of students
1-	Undergraduate elective	46
2-	Undergraduate Compulsory	
	Hort. 201	200
	Hort. 311 - I	38
3-	Post-graduate	
	M.Sc.	5
	Ph.D.	4

Eight M.Sc. and five Ph.D. students submitted their theses during the year under report.

Title of Theses of M.Sc. students

1- Developmental physiology of ber (Zizyphus mauritiana Lamb.)

2- Floral biology of Almonds.

3- Inducing fruitfulness in Anab-e-Shahi grapevines.

4- Micro-nutrient studies on grapes (Vitis vinifera L.) cultivar Thompson Seedless.

5- Studies on storage of Dusehari mangoes (Mangifera indica L.)

6- Seed germination studies in Apricot and peach.

7- Effect of nitrogen, phosphorus and potassium on vigour, yield and quality of sharbati peach (Prunus possica Batsch).

8- Studies on the physical and bio-chemical changes during development and ripening of Patharnakh cultivar of pear (Pyrus pyrifolia (Burm) Nakai.

Title of Theses of Ph.D. students

1- Crop regulation in guava (Psidium gaujava L.).

2- Responses surface studies on nitrogen, phosphorus and potassium in perlette cultivars of grape.

3- Studies on the physiology of rooting in pear (Pyrus pyrifolia L.) cuttings.

4- Studies on the bearing behaviour of Mango (Magifera indica L.) and its malformation.

5- Growth and chemical composition of citrus root-stocks as influenced by various levels of exchangeable sodium and salivity in soil.

S E M I N A R S

Five class seminars as well as thirteen seminars on theses were organised.

Postgraduate courses taught alongwith the names of teacher(s) and number of students

Course No.	Name of teacher		No. of students
	Theory	Practical	
Hort. 502	Dr. G. S. Nijjar	Shri Gurcharan Singh	6
Hort. 503	Dr. G. S. Nijjar	Shri Gurcharan Singh	9
Hort. 504	Dr. B. S. Dhillon	Shri J. S. Randhawa	10
Hort. 505	Dr. Prem Singh/ Dr. A. S. Bindra	Shri S.S. Gill	9
Hort. 506	Dr. S. S. Grewal	Shri Gurcharan Singh	6
Hort. 508	Dr. J. S. Jawanda	Dr. H. N. Khajuria	5
Hort. 557	Dr. A. S. Dhatt/ Dr. J. S. Bhullar	Dr. A. S. Dhatt/ Dr. J. S. Bhullar	3

Hort. 591	Dr. B. S. Dhillon/ Dr. A. S. Bindra	-	5
Hort. 602	Dr. B. S. Dhillon	-	6

Postgraduate students on roll during the year :-

At present 17 postgraduate students are on roll, as per details given below :-

Class	Year of Admission	No. of students
M.Sc.	1974-75	5
	1975-76	5
Ph.D.	1973-74	2
	1974-75	1
	1975-76	4

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R E S E A R C H

1 CITRUS

H-1.1(A) i : Varietal trial on sweet orange for arid-irrigated regions of Punjab

S.K. Kalra, J.N. Sharma and G.S. Chohan

In order to find out all round best cultivar(s) for the agro-climatic conditions prevalent in the arid-irrigated regions of Punjab, a varietal trial comprising Jaffa, Blood Red, Pineapple, Hamlin, Musambi and Valencia sweet oranges on Jatti Khatti (C. jambhiri L.) was laid out in September, 1961. The experiment was laid by randomised block design with 5 trees per plot which were replicated six times.

Vigour and growth of trees

The data pertaining to various parameters of growth is summarised in Table 1.

TABLE 1 : Mean growth (cm) of 14-year-old trees of sweet orange trial recorded in February, 1976

Cultivar	Trunk girth		Tree spread		Height
	Stock	Scion	East-west	North-South	
Jaffa	79.4	69.9	590	626	416
Blood Red	67.3	59.9	465	436	344
Pineapple	64.6	58.4	475	466	342
Hamlin	82.6	66.3	591	616	402
Musambi	77.0	65.5	533	527	373
Valencia	87.4	73.2	625	668	428
C.D. at 5%	5.8	3.8	35	47	21

An overall appraisal of growth data with respect to their girth, height and spread reveals that Valencia and Jaffa were the most vigorous cultivars whereas Blood Red and Pineapple had the least vigour. The other two cultivars - Musambi and Hamlin - were intermediate in vigour. Musambi was lagging behind in respect of tree spread and height, though the trunk girth was statistically similar to Hamlin. The trend of growth, in general, is in agreement with the observations made in the previous years.

Fruit yield :

Fruit yield data for the 10th year of bearing are presented in Table 2.

TABLE 2 : Mean fruit weight and yield of 14-year-old sweet orange trees under the varietal trial

Cultivar	Av. weight per fruit (g)	Av. No. of fruits/ tree	Total yield per tree (kg)
Jaffa	191	365	69.715
Blood Red	187	210	39.270
Pineapple	222	275	61.050
Hamlin	208	282	58.656
Musambi	193	285	55.005
Valencia	235	185	43.475
C.D. at 5%	17	84	

Jaffa trees yielded maximum number of fruits (365) followed by Musambi (285) and Hamlin (282), though the yield of the three cultivars was on a par statistically. Valencia gave minimum yield of 185 fruits (as in the previous years) followed in ascending order by Blood Red (210)

and Pineapple (275). However, the difference between these cultivars were non-significant.

Fruit quality :

Average weight per fruit was maximum in case of Valencia (235 g) and minimum in Blood Red (187 g).

Juice content was maximum in Valencia (46.7%) when compared with all other cultivars whereas Hamlin (38.9%) had the least of all. Other four cultivar were statistically at par in this respect though Blood Red was leading. Peel percentage was highest in Blood Red and it was closely followed by that of Jaffa and Pineapple. The values were the lowest in Hamlin and Musambi, Valencia had significantly more peel than these two cultivars.

The juice of Musambi contained maximum total soluble solids (9.75%) and that of Valencia (8.36%) the minimum, but the values were statistically non-significant. Acidity was minimum in Musambi (0.360 g/100 ml) and maximum in Valencia (1.024 g/100 ml), while Jaffa, Blood Red, Pineapple and Hamlin were on a par in this respect.

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H-1.1 (B) : Varietal trial on mandarins

M.R. Gupta and Research Assistant

During August, 1970 five plants each of the nine cultivars of these species namely Kinnow, Wilking, Dancy, Srinagar, Lahore Local, Nagpur, SZ-IN-CON, Feutrals' Early and Unshiu were planted as an observational trial. It was proposed to lay out a regular trial on these cultivars later on, but due to the non-production of uniform plant material, this trial could not be planted so far. Observations recorded on the existing material showed that Kinnow, Wilking, Feutrals' Early and SZ-IN-CON gave very good performance with respect to fruit yield and quality. Dancy fruits were found highly granulated.

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H-1.1 (BT) : Collection of citrus germplasm

R.C. Sharma and P.S. Sarowa

Four plants each of 90 species/cultivars have been planted in the field. The mortalities which have occurred are being replaced. The initial data on girth measurement have been recorded. The seeds of 34 cultivars/species from I.A.R.I., New Delhi and 8 cultivars from Virus Research Station, Poona were obtained and sown in the nursery. The seeds of 13 cultivars out of 42 cultivars did not germinate. Besides these, the seeds of 17 cultivars/species were collected from Regional Fruit Research Station, Abohar and sown in the nursery. The plants of some 29 cultivars/seeds received from Indian Agricultural Research Institute, New Delhi and Poona and 17 cultivars from Regional Fruit Research Station, Abohar will be ready for transplantation in the field during March, 1977.

**

H-1.2 (A) i : Rootstock trial on sweet orange

M.S. Bajwa, V.K. Vij and S.K. Munshi

This trial was laid out in 1968-69 with an object to select suitable rootstock(s) for sweet orange for arid-irrigated regions of the Punjab. Five commercial cultivars of sweet orange were budded on 8 to 4 rootstocks as detailed below :-

Scion cultivar	Rootstocks
Blood Red	1- Jatti Khatti (C. jambhiri Lush)
	2- Kharna Khatta (C. Karna Raf.)
	3- Troyer } Citranges (P. trifoliata x
	4- Carrizo } Citranges C. sinensis)
	5- Rangpur Lime (C. limonia Osbeck)
	6- Pectinifera (C. pectinifera)
	7- Cleopatra (C. reshni Tanaka)
	8- Citrumelo (P. trifoliata x C. paradisi)

Musambi	1-	Jatti Khatti
	2-	Kharna Khatta
	3-	Troyer
	4-	Carrizo
	5-	Rangpur Lime
	6-	Pectinifera
	7-	Jambhiri (C. jambhiri Lush.)
	8-	Citrumelo
Jaffa	1-	Jatti Khatti
	2-	Kharna Khatta
	3-	Troyer
	4-	Carrizo
	5-	Rangpur Lime
	6-	Pectinifera
	7-	Pineapple (C. sinensis Osbeck)
	8-	Citrumelo
Valencia	1-	Jatti Khatti
	2-	Kharna Khatta
	3-	Troyer
	4-	Carrizo
	5-	Rangpur Lime
	6-	Cleopatra
	7-	Citrumelo
Pineapple	1-	Jatti Khatti
	2-	Kharna Khatta
	3-	Troyer
	4-	Carrizo
Tree unit per plant	:	Three
Replications	:	Four
Experimental design	:	R B D
Date of planting	:	1- Blood Red on first four rootstocks - September, 1968
		2- All other material - September, 1969.

The data on various growth attributes and fruit yield were recorded during the year 1975-76 and the performance of different cultivars is discussed below sciowise.

1- Blood Red

A perusal of the data in Table 3 (part A) shows that Blood Red trees budded on Jatti Khatti have significantly more growth as compared to all other rootstocks. The scion-stock ratio for Jatti Khatti and Kharna Khatta was significantly better than that of Troyer and Carrizo. Blood Red/Jatti Khatti gave maximum yield 192.6 fruits per tree, which was significantly higher than that obtained on all other rootstocks. Kharna Khatta and Troyer were found on a par with each other, but both were significantly better than Carrizo in fruit yield.

TABLE 3 : Effect of different rootstocks on growth and yield of Blood Red

Rootstocks	Trunk girth (cm) Stock	Scion	Scion/ stock ratio	Tree volume (m^3)	Yield (number of fruits/tree)
Part A					
Jatti Khatti	51.1	43.0	0.84	25.2	192.6
Kharna Khatta	30.1	24.5	0.81	12.6	63.3
Troyer	34.7	24.5	0.70	12.0	42.6
Carrizo	31.7	21.0	0.66	9.7	15.0
C.D. at 5%	3.71	2.53	0.036	1.67	25.45
Part B					
Rangpur Lime	16.1	13.1	0.81	5.5	11.5
Pectinifera	30.8	27.0	0.88	10.9	51.4
Cleopatra	42.3	39.0	0.92	20.9	79.7
Citrumelo	48.9	32.7	0.67	16.6	80.6
C.D. at 5%	6.42	3.75	0.086	3.91	28.50

Blood Red raised on Cleopatra maintained its superiority in terms of scion-stock ratio and tree volume (Table 3, part B). Blood Red/ Rangpur Lime has shown the poorest growth performance. Blood Red/Citrumelo has displayed significantly low scion-stock ratio. Number of fruits per tree borne on Citrumelo, Cleopatra and Pectinifera were on a par amongst themselves and were found significantly better than Rangpur Lime.

2- Musambi

Originally the trial was planted on eight rootstocks but trees on Citrumelo, Troyer and Carrizo rootstocks died subsequently. The data (Table) on growth attributes show that stock girth was maximum in Jambhiri rootstock followed by Jatti Khatti and Rangpur Lime and these rootstocks showed significantly more stock girth than Kharna Khatta and Pectinifera. While comparing the scion-stock ratio, Pectinifera, Kharna Khatta and Rangpur Lime were found significantly superior (although at par with each other) than Jatti Khatti and Jambhiri. Regarding tree volume, trees on Jatti Khatti have displayed highest values, which were at par with Kharna Khatta, Rangpur Lime and Jambhiri, though significantly better than Pectinifera. The data regarding fruit yield were non-significant. However, tree on Jatti Khatti bore maximum number of fruits, followed by Kharna Khatta, Jambhiri, Rangpur Lime and Pectinifera in the descending order.

TABLE 4 : Effect of different rootstocks on growth and yield of Musambi

Rootstock	Trunk girth (cm) Stock	Scion	Scion/ stock ratio	Tree volume (m^3)	Yield (No.of fruit /tree
Jatti Khatti	41.7	50.6	0.83	28.1	211.6
Kharna Khatta	38.7	43.6	0.89	25.5	199.2
Rangpur Lime	41.7	46.4	0.89	27.2	189.3
Pectinifera	39.5	42.9	0.92	22.9	134.0
Jambhiri	39.2	51.2	0.76	25.9	191.6
C.D. at 5%	N S	5.23	0.05	5.09	N S

5- Jaffa

The data in Table 5 show that Jaffa budded on Jatti Khatti had significantly better growth performance than all other rootstocks. On the other hand, Rangpur Lime gave the poorest figures. Pineapple and Citrumelo were superior than citranges in tree volume and scion girth. Stock-scion ratio was statistically alike of trees on Jatti Khatti, Kharna Khatta, Pineapple, Pectinifera, Rangpur Lime and Troyer. However, this ratio of Citrumelo and Carrizo was significantly less.

TABLE 5 : Effect of different rootstocks on growth and yield of Jaffa

Rootstock	Trunk girth (cm)		Scion/ stock ratio	Tree Volume (m^3)	Yield (No.of fruits/ tree)
	Stock	Scion			
Jatti Khatti	46.7	41.8	0.89	25.9	215.5
Kharna Khatta	26.2	22.8	0.87	11.8	51.7
Troyer	37.4	30.4	0.81	15.8	114.8
Carrizo	34.5	25.4	0.74	13.8	68.5
Rangpur Lime	17.5	14.5	0.83	5.1	3.2
Pectinifera	36.4	32.5	0.89	17.9	100.4
Pineapple	40.9	36.7	0.90	19.6	49.5
Citrumelo	48.7	34.5	0.71	17.8	84.0
C.D. at 5%	7.34	6.07	0.09	3.93	52.21

Jaffa/Jatti Khatti trees excelled all others in fruit yield. However, Kharna Khatta, Carrizo, Pectinifera, Pineapple and Citrumelo were on a par with each other. Jaffa/Rangpur Lime trees bore minimum number of fruits per tree.

4- Valencia

The data on tree volume were found to be non-significant, although

Jatti Khatti had maximum tree volume and Rangpur Lime the minimum. The data on scion growth was also non-significant. The stock girth was the greatest in Citrumelo than all others. The scion-stock ratio (Table 6) in Valencia/Rangpur Lime, Kharna Khatta and Cleopatra was the highest amongst all the rootstocks and on a par with each other. However, Citrumelo gave the lowest scion-stock ratio.

Regarding yield, Valencia/Troyer bore significantly more number of fruits than Rangpur Lime, Cleopatra and Citrumelo stocks, but found to be at par with Jatti Khatti, Kharna Khatta and Carrizo.

TABLE 6 : Effect of different rootstocks on growth and yield of Valencia trees

Rootstocks	Trunk girth (cm)		Scion/ Stock ratio	Tree Volume (m^3)	Yield (No. of fruits/ tree)
	Stock	Scion			
Jatti Khatti	48.2	39.8	0.82	26.9	91.5
Kharna Khatta	43.5	39.2	0.91	23.9	89.1
Troyer	47.9	38.7	0.81	24.9	101.1
Carrizo	45.8	36.9	0.80	22.1	79.6
Rangpur Lime	39.5	36.3	0.92	19.6	70.6
Cleopatra	46.0	39.3	0.85	23.9	53.9
Citrumelo	57.5	36.6	0.65	25.1	50.8
C.D. at 5%	4.2	N S	0.09	N S	28.57

5- Pineapple

The data on various growth characters in Pineapple/Jatti Khatti (Table 7) have revealed maximum values in terms of scion and stock girth as well as tree volume. The scion-stock ratio in Jatti Khatti and Kharna Khatta was significantly higher than of Carrizo. However, Jatti Khatti

and Troyer were at par. The data on tree volume and yield were found to be non-significant. Jatti Khatti has maintained the lead over all other rootstocks in yield.

TABLE 7 : Effect of different rootstocks on growth and yield of Pineapple trees

Rootstock	Trunk girth (cm) Stock	Scion	Scion/ stock ratio	Tree Volume (m^3)	Yield (No.of fruits/ tree)
Jatti Khatti	53.6	46.9	0.88	26.3	178.0
Kharna Khatta	42.6	39.2	0.92	25.9	140.0
Troyer	50.6	42.5	0.84	23.1	138.2
Carrizo	41.9	38.1	0.79	22.9	161.2
C.D. at 5%	2.10	2.72	0.04	N S	N S

Conclusions :

From the above results, it may be concluded that Blood Red/Jatti Khatti and Cleopatra trees have shown superiority in growth over other rootstocks. Trees of Blood Red on Kharna Khatta have developed severe bark cracking on the stock portion. Blood Red on Rangpur Lime and Pectinifera are extremely dwarfed. Musambi budded on Rangpur Lime and Kharna Khatta has maintained good performance. Troyer and Carrizo citranges so far have given satisfactory performance as rootstock for Jaffa scion. Valencia on Rangpur Lime has also given good performance. Citrumelo rootstock has continued to give unsatisfactory performance in case of all the scion cultivars. All the trees on this stock have over-growth on the stock portion and thus the scion-stock ratio has been the lowest.

**

H-1.2 (A) ii : Varietal-cum-rootstock trial with new promising citrus varieties

M.S. Bajwa, J.N. Sharma, S.K. Munshi
and P.S. Sarowa

In order to select suitable rootstock(s) for some of the new promising citrus varieties, varietal-cum-rootstock trial was laid out in September,1968 with the following details :-

Scion cultivars (Four)

1- Wilking

2- Kinnow

3- Pearl

4- Campbell Valencia

Rootstocks (Four)

1- Jatti Khatti (C. jambhiri Lush.)

2- Kharna Khatta (C. Kharna Raf.)

3- Troyer ¦ Citranges (P. trifoliata x C. sinensis)

4- Carrizo ¦

Replications : Four

Tree unit per plot : Three

Design of layout : Split-plot

Data on growth were recorded during February,1976 and number of fruits were counted in September,1975 and are discussed below :-

Stock girth

The data presented in Table 8 reveal that amongst scion varieties, Campbell Valencia had significantly more stock girth (51.8 cm) than that of Kinnow and Wilking whereas it was on a par with Pearl. Jatti Khatti excelled all other rootstocks with significantly more stock girth

(49.0 cm) than Kharna Khatta while it was on a par with Troyer and Carrizo rootstocks.

TABLE 8 : Mean stock girth (cm) of trees of various stionic combinations

Scion/Rootstock	Jatti Khatti	Kharna Khatta	Troyer	Carrizo	Mean
Wilking	35.3	34.1	36.8	34.5	35.1
Kinnow	50.4	44.7	47.7	50.0	48.2
Pearl	53.4	45.9	53.4	52.7	51.3
Campbell Valencia	56.9	46.7	49.5	54.0	51.8
Mean	49.0	42.8	46.8	47.8	
C.D. at 5%	(a) Scion	-3.19			
	(b) Rootstock	-2.54			
	(c) Interaction	(Scion x stock) - N S			

Scion girth :

Scion girth of Pearl was significantly more (44.1 cm) than of Kinnow and Wilking whereas it was on a par with Pearl. Wilking had the least (31.9 cm) scion girth (Table 9).

TABLE 9 : Mean scion girth (cm) of trees of various stionic combinations

Scion	Rootstock				
	Jatti Khatti	Kharna Khatta	Troyer	Carrizo	Mean
Wilking	32.3	33.5	31.1	30.9	31.9
Kinnow	42.4	42.9	39.3	39.8	41.1
Pearl	45.2	44.2	43.8	43.3	44.1
Campbell Valencia	47.4	43.2	41.3	43.2	43.8
Mean	41.8	39.7	38.9	39.3	
C.D. at 5%	(a) Scion	- 2.08			
	(b) Rootstock	- 1.76			
	(c) Interaction (Scion x stock)	- N S			

Trees raised on Jatti Khatti stock had significantly greater scion girth (41.8 cm) than the trees raised on Kharna Khatta, Carrizo and Troyer in the descending order, all of which were on a pa with one another.

Tree Volume :

Campbell Valencia and Pearl trees though at par had significantly greater tree volume than Kinnow and Wilking scions (Table 10). The latter had the lowest tree volume (14.09 m^3) of all the four scions. Amongst rootstocks, as in the previous years, this year also Kharna Khatta had the maximum tree volume. Troyer and Carrizo rootstocks produced poor growth in tree volume. Results were, however, non-significant.

TABLE 10 : Mean tree volume (m^3) of trees of various stionic combinations

Scion	Rootstocks				Mean
	Jatti Khatti	Kharna Khatta	Troyer	Carrizo	
Wilking	13.53	15.79	13.92	13.14	14.09
Kinnow	24.52	25.57	21.99	24.78	24.21
Pearl	27.80	26.16	25.61	27.81	26.84
Campbell Valencia	29.47	28.67	26.64	26.06	27.72
Mean	23.83	24.05	22.04	22.95	
C.D. at 5%	(a) Scion		- 2.13		
	(b) Rootstocks		- N S		
	(c) Interaction (scion x stock)		- N S		

Fruit Yield :

Kinnow scion significantly produced more fruits (282.2/tree) than that of Wilking, Pearl and Campbell Valencia scions (Table 11).

TABLE 11 : Mean fruit yield (Number) of trees of various stionic combinations

Scion	Rootstock				Mean
	Jatti Khatti	Kharna Khatta	Troyer	Carrizo	
Wilking	292.2	278.2	240.2	196.0	251.7
Kinnow	286.7	335.5	271.0	210.5	282.2
Pearl	143.5	181.5	192.7	187.0	176.2
Campbell Valencia	08.2	161.7	155.0	162.0	146.7
Mean	207.7	239.2	214.7	195.1	

C.D. at 5%
(a) Scion - 71.02
(b) Rootstock - N S
(c) Interaction (scion x stock) - N S

Campbell Valencia produced the least number (146.7) of fruits this year. Kharna Khatta stock yielded more fruits (239.2) with Kinnow. The results were, however, non-significant.

Nutritional status of the leaves :

Macronutrients : A perusal of data in Table 12 would reveal that different rootstocks did not influence the N, P, K, Ca & Mg levels in the leaves of various scion cultivars significantly. However, Kharna Khatta translocated highest K, Jatti Khatti - highest Ca and Citranges on an average higher Mg than either Jatti Khatti or Kharna Khatta. Amongst scion cultivars too, the results were non-significant. However, phosphorus content in the leaves of Pearl/Jatti Khatti was significantly lower than other stionic combinations. Pearl/Kharna Khatta translocated higher K than all other stionic combinations.

TABLE 12 : Nutritional status of the leaves of different promising varieties in citrus (Macronutrients)

Nutrients/Scion varieties	Rootstocks				
	Jatti Khatti	Kharna Khatta	Troyer	Carrizo	Mean
Nitrogen					
Kinnow	2.53	2.56	2.42	2.50	2.50
Wilking	2.54	2.50	2.40	2.45	2.47
Pearl	2.37	2.38	2.41	2.44	2.40
Campbell Valencia	2.42	2.41	2.35	2.43	2.40
Mean	2.47	2.46	2.40	2.46	
Phosphorus					
Kinnow	0.18	0.17	0.15	0.17	0.17
Wilking	0.16	0.15	0.20	0.16	0.17
Pearl	0.15	0.17	0.18	0.18	0.17
Campbell Valencia	0.16	0.16	0.16	0.16	0.16
Mean	0.16	0.16	0.17	0.17	0.17
Potassium					
Kinnow	1.22	1.40	1.40	1.32	1.34
Wilking	1.39	1.55	1.66	1.52	1.53
Pearl	1.48	1.71	1.63	1.53	1.59
Campbell Valencia	1.35	1.59	1.44	1.30	1.42
Mean	1.36	1.56	1.53	1.42	
Calcium					
Kinnow	4.54	3.88	3.36	3.96	3.69
Wilking	3.49	3.50	3.35	3.64	3.49
Pearl	3.79	3.22	3.35	3.55	3.48
Campbell Valencia	4.13	3.74	4.29	4.32	4.12
Mean	3.99	3.59	3.59	3.87	
Magnesium					
Kinnow	0.34	0.27	0.32	0.34	0.32
Wilking	0.29	0.25	0.35	0.32	0.30
Pearl	0.28	0.22	0.39	0.33	0.31
Campbell Valencia	0.27	0.25	0.33	0.32	0.29
Mean	0.29	0.24	0.35	0.33	

C.D. at 5%

	Scion	Stock	Scion x stock
Nitrogen	N S	N S	N S
Phosphorus	N S	N S	0.02
Potassium	N S	N S	N S
Calcium	N S	N S	N S
Magnesium	N S	N S	N S

Pearl/Troyer had highest Mg content in the leaves as against general Mg deficiency prevalent in this area.

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Micronutrients :

Zinc was found invariably in the deficient range and various stionic combinations did not affect its content significantly. The values in the leaves varied from 11.88 ppm to 16.31 ppm in Campbell Valencia/Carrizo and Wilking/Kharna Khatta combinations. Copper on the other hand, remained in the sufficient range in all the stionic combinations. The data for Zn and Cu were found to be non-significant. Kharna Khatta on an average displayed higher Mn content in the leaves, which was followed by Jatti Khatti (at par with Kharna Khatta). The citranges, i.e. Troyer and Carrizo contained significantly lower Mn content in the leaves than their Rough Lemon counterparts. Regarding scion varieties, Pearl displayed significantly higher values of Mn than Campbell Valencia, Kinnow & Wilking (Table 13). However, the interaction for Mn between scion & stock varieties was found to be non-significant.

TABLE 13 : Nutritional status of the leaves of different promising varieties in citrus (Micronutrients)

Nutrients/Varieties	Rootstocks				Mean
	Jatti Khatti	Kharna Khatta	Troyer	Carrizo	
1	2	3	4	5	6
Zinc					
Kinnow	15.50	15.35	12.69	13.72	14.32
Wilking	14.44	16.31	15.73	13.85	15.08
Pearl	15.22	12.94	15.44	15.50	14.80
Campbell Valencia	14.50	15.75	14.75	11.88	14.22
Mean	14.92	15.09	14.65	13.74	
Copper					
Kinnow	5.17	4.91	6.32	6.70	5.80
Wilking	7.19	5.02	6.59	5.09	5.97
Pearl	5.06	4.94	7.90	5.85	6.14
Campbell Valencia	5.63	6.50	5.98	6.38	6.12
Mean	5.96	5.34	6.69	6.01	

Contd.....

1	2	3	4	5	6
Manganese					
Kinnow	38.2	48.4	30.0	32.8	37.6
Wilking	36.6	43.5	20.0	26.3	31.6
Pearl	52.5	68.5	22.5	28.2	42.9
Campbell Valencia	47.2	42.2	36.6	30.0	39.0
Mean	43.6	50.9	27.3	29.3	
Iron					
Kinnow	97	122	123	114	114
Wilking	100	110	93	87	98
Pearl	87	133	87	97	101
Campbell Valencia	95	107	102	87	98
Mean	95	118	101	96	

C.D. at 5%	Scion	Stock	Scion x stock
Manganese	4.70	7.73	N S
Iron	N S	6.58	N S

Kharna Khatta excelled all other rootstocks in translocating Fe in the leaves. The values on an average were 118 ppm for Kharna Khatta which was significantly higher than that of Troyer, Carrizo and Jatti Khatti respectively. Amongst scion varieties Kinnow contained the highest values (114 ppm). However, the data for scion and its interaction with the rootstocks were non-significant.

**

H-1.2 (GM) i : Rootstock trial on mandarins

J.S. Kanwar and Horticulturist

It is proposed to test the performance of three scion cultivars on five rootstocks with a view to find out the best stionic combination for the sub-montaneous tract of the State.

Scions	:	Kinnow, Dancy and Desi Sangtra
Rootstocks	:	Jatti Khatti, Kharna Khatta, Troyer, Cleopatra and Poncirus trifoliata.
Replication	:	Four
Plant unit/ treatment	:	Three
Experimental design	:	Split plot
Total number of experimental plants	:	180
Planting distance:		6 x 6 m

The plant material is being raised for this trial and it shall be planted in the field when it is ready for transplanting.

**

H-1.2 (L) i: Rootstock trial on sweet orange

Horticulturist, M.P.Singh and K.K. Sharma

In order to find out suitable rootstock(s) for sweet orange cv. Blood Red, this field trial was laid out in February, 1969.

Rootstocks :	:	Nine
	1-	Jatti Khatti (C. Jambhiri Lush.)
	2-	Kharna Khatta (C. Karna Raf.)
	3-	Troyer ¦ Citranges (P. trifoliata x
	4-	Carrizo ¦ C. sinensis)
	5-	Rangpur Limo (C. limonia Osbeck)
	6-	Cleopatra (C. reshni Tanaka)
	7-	Pectinifera (C. pectinifera)
	8-	Citrumelo (C. paradisi x P. trifoliata.)
	9-	Nucellar Blood Red
Scion	:	Blood Red
Tree Unit	:	Four plants for all treatments except at Sr.No. 7 and 8 where it is two.
Replications	:	Four
Experimental Design	:	R B D
Planting distance:		6 x 6 meters

The plants on first four rootstocks were planted in field during February, 1969 and plants on rest of the five rootstocks during July, 1969. The data on various growth parameters are summarized in Table 14 and are discussed attribute-wise.

TABLE 14 : Effect of rootstock on the growth of Blood Red plants

Treatments	Tree height (m)	Trunk girth (cm) Stock	Trunk girth (cm) Scion	Tree spread (m)
A : Planted in February, 1969				
Jatti Khatti	3.41	44.43	38.42	3.00
Kharna Khatta	2.36	31.89	24.70	2.13
Troyer	2.54	32.92	26.26	1.83
Carrizo	2.07	28.86	22.36	1.68
C.D. at 5%	N S	10.08	4.53	N S
B : Planted in July, 1969				
Rangpur Lime	0.98	12.64	10.89	0.76
Cleopatra	2.66	35.23	30.31	2.24
Pectinifera	2.16	24.10	20.03	1.44
Citrumelo	2.83	45.97	33.75	2.27
Mucellar Blood Red	3.26	31.34	28.92	2.13
C.D. at 5%	N S	N S	N S	N S

Tree height

The height of the Blood Red trees on all the nine rootstocks was not statistically significant. However, in group A the maximum height (3.41 m) was on the Jatti Khatti rootstock and the minimum (2.07 m) on

Carrizo. In group B, the Nucellar Blood Red plants were having the maximum (3.26 m) height whereas those on Rangpur Lime the least height (0.98 m).

Tree spread

The tree spread was also not significantly affected on the rootstocks in group A and group B. The maximum (3.00 m) spread in group A was on Jatti Khatti and second best (2.27 m) in group B on Citrumelo rootstock.

Stock girth

In group A, Jatti Khatti stock girth (14.43 cm) was significantly greater than rest of the rootstocks. In group B the stock girth was not significantly affected. However, the highest (15.97 cm) girth was of Citrumelo stock and the lowest (12.64 cm) of Rangpur Lime.

Scion girth

In group A, the scion girth (38-42 cm) was significantly more on Jatti Khatti rootstock. In group B, the scion girth was not significantly affected. However, maximum scion girth (35.75 cm) was on Citrumelo and the minimum (10.89 cm) on Rangpur Lime.

**

H-1.3 (A) i : Effect of graded doses of nitrogen on the growth yield and quality of sweet orange cv. Blood Red

S.K. Kalra and S.K. Munshi

The experiment was laid out in March, 1967 on 4½ year old Blood Red sweet orange trees with a view to find out the most economical doses of nitrogen under arid-irrigated conditions. The following differential doses of N were applied :-

T_1	Control (No fertilizer)
T_2	28 g N per year age of tree
T_3	56 g N per year age of tree
T_4	84 g N per year age of tree
T_5	112 g N per year age of tree
T_6	140 g N per year age of tree

The experiment was laid out by randomised block design with four replications and four trees as a unit in each replication. The application of N were made in February every year. The doses of nitrogen were made constant after the 8th year of the age of the tree. Since the differential doses of N failed to give any response, P_2O_5 at the rate of 200 g per tree was added to two of the four trees under each treatment (the other two received only N) from 1974. This modification has been made to find out whether P affects the yield, growth and physico-chemical characteristics of fruits.

Vigour of trees

The data on various growth attributes and yield are given in Table 15. The data showed that the differential N applications did not affect the growth and yield of trees, although minimum growth as well as yield were observed in trees under the control

TABLE 15 : Effect of different doses of nitrogen on the growth and yield of Blood Red sweet orange (1975-76)

Treatment		Stock girth	Scion girth	Height	Spread	Yield
Control	(T_1)	58.5	51.9	327	425	195
28 g N	(T_2)	61.2	55.6	337	463	206
56 g N	(T_3)	61.4	56.8	334	466	214
84 g N	(T_4)	62.9	56.3	341	466	218
112 g N	(T_5)	61.2	55.5	332	465	195
140 g N	(T_6)	61.8	57.3	335	460	218
C.D. at 5%		N S	N S	N S	N S	N S

Fruit quality

The physico-chemical analysis of fruits from trees under different treatments (Table 16) revealed that the differential fertilizers treatments failed to affect the fruit quality. This particular field trial has been in progress for the last nine years but no definite results have been obtained except that the control trees (receiving no nitrogen) were slightly less vigorous than those receiving nitrogen.

TABLE 16 : Effect of different doses of nitrogen on physico-chemical analysis of fruit of sweet orange (1975-76)

Treatment		Weight/ fruit(g)	Juice %	Peel %	Rag. %	T S S %	Acidity
Control	(T_1)	170	44.5	35.7	19.8	8.0	0.656
28 g N	(T_2)	171	43.0	35.6	21.4	8.0	0.681
56 g N	(T_3)	165	40.5	36.2	23.3	8.2	0.684
84 g N	(T_4)	165	40.7	36.4	22.9	8.1	0.691
112 g N	(T_5)	171	42.0	36.6	21.4	8.4	0.723
140 g N	(T_6)	162	42.3	35.0	21.7	8.3	0.752
C.D. at 5%		N S	N S	N S	N S	N S	N S

**

H-1.3 (A) ii : Varietal-cum-fertilizer trial on grapefruit

S.K. Kalra and S.K. Munshi

The trial was initiated in 1968 to find out the most suitable commercial cultivar(s) of grapefruit for arid-irrigated regions represented by Abohar and their optimum nitrogen requirements. The layout was by split-plot design with cultivars, viz. Marsh Seedless, Duncan and Foster in the main plots and fertilizer doses in the sub-plots. The doses are given below :-

N_0 Control
N_1 30 g of N per year age of the tree
N_2 60 g of N per year age of the tree
N_3 90 g of N per year age of the tree

Three trees comprised a unit in each of the four replications. A basal dose of 10 kg farmyard manure was applied to all the trees, including those of the control and the N applied in this form was not accounted for towards the total N to be added under different treatments.

The differential doses were applied during February every year.

Vigour of trees

The data on various attributes of growth (Table 17) show that the differential doses of N failed to affect the vigour of trees in any significant manner in all the cultivars. Trees of Foster were somewhat less vigorous than those of the other two cultivars in respect of trunk girth, tree height and spread.

Yield and physico-chemical characters

The yield as given in Table 18 show that the trees under the control, gave significantly less number of fruits than N_2 or N_3, but this remained at par with N_1. However, there was no significant difference between the treatments receiving N. Amongst the other physico-chemical characteristics, the only significant character was the acidity. It was lower in Marsh Seedless than the other two varieties.

**

H-1.3 (A) iii : Nutritional trial on cv. Kinnow mandarin

V.K. Vij, S.K. Munshi and M.S. Mann

This experiment was laid out in February, 1973 on the plants planted in September, 1971 with a view to find out the optimum dose(s) of

TABLE 17 : Effect of differential N applications on vigour of grapefruit trees in varietal-cum-fertilizer trial (1975-76)

	Stock girth (cm)				Scion girth (cm)				Height (cm)				Spread (cm)			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
N_0	42.3	40.0	40.0	40.8	42.6	39.5	39.8	40.6	290	275	265	277	325	299	310	311
N_1	42.3	45.9	40.1	42.1	40.6	43.6	40.2	41.5	275	290	267	277	322	331	320	324
N_2	44.8	42.3	39.9	42.5	44.0	42.4	38.3	41.6	303	280	265	283	348	342	313	334
N_3	43.2	46.7	39.9	43.3	42.1	45.2	38.2	41.8	293	289	274	287	342	361	326	343
Mean	43.2	45.2	40.0		42.3	42.7	39.1		291	289	268		446	444	423	

V_1 = Marsh Seedless

V_2 = Duncon

V_3 = Foster

TABLE 18 : Effect of differential N applications on yield and physico-chemical characteristics of fruits in varietal-cum-fertilizer trial on grapefruit

	Yield				Weight per fruit (g)				Juice %				Peal %			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
N_0	96	87	100	94	455	612	486	518	39.1	37.8	37.6	38.2	36.7	36.7	37.1	36.8
N_1	88	152	149	130	522	598	450	523	39.8	40.8	38.9	39.8	37.0	34.1	34.4	35.2
N_2	104	140	167	137	524	572	469	522	41.8	41.7	40.5	41.3	34.5	33.7	35.2	34.5
N_3	142	147	181	158	519	551	461	510	39.3	40.8	38.5	39.5	37.8	35.8	36.2	36.6
Mean	107	132	150	-	505	583	467	-	40.0	40.3	38.9	-	36.0	35.0	35.7	-

	Rag. %				T.S.S. in Juice				Acidity g/100 ml of juice			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
N_0	24.2	25.5	25.3	25.0	7.02	7.58	8.07	7.56	1.065	1.260	1.321	1.215
N_1	23.2	25.1	26.7	25.0	7.02	7.83	7.72	7.52	1.020	1.245	1.216	1.150
N_2	23.7	24.6	24.3	24.2	6.92	7.73	8.25	7.63	1.075	1.197	1.289	1.187
N_3	22.9	23.4	25.3	23.9	7.07	7.73	7.87	7.56	1.149	1.280	1.213	1.214
Mean	23.5	24.7	25.4	-	7.01	7.72	7.98	-	1.077	1.245	1.260	-

Yield C.D. at 5% for fertilizer - 39

Acidity C.D. at 5% for varieties - 0.088

The results for other characteristics are non-significant

nitrogen and phosphorus for Kinnow budded on Jatti Khatti. The fertilizer treatments given are detailed below :-

Treatments : 12 in all combinations of N_1, N_2, N_3, N_4 and P_0, P_1 and P_2.

N_1 25 g N/year age of the tree
N_2 50 g N/year age of the tree
N_3 100 g N/year age of the tree
N_4 150 g N/ ear age of the tree

P_0 0 g P_2O_5/year age of the tree
P_1 50 g P_2O_5/year age of the tree
P_2 100 g P_2O_5/year age of the tree

There were five replications and the trial was laid out in randomised block design.

Effect on vigour

The differential doses of nitrogen ($\frac{1}{2}$ dose) and phosphorus alongwith Potassium (50 g of K_2O) and 20 kg of FYM (as a basal dose) were applied in February, 1976. The remaining half dose of nitrogen was applied in June, 1976.

The data recorded in various aspects (Table 19) show that the trunk girth and spread of the trees were not affected by any of the treatments so far.

TABLE 19 : Mean growth of plants under the nutritional trial (February, 1976)

Treatment	Tree girth (cm) Stock	Scion	Tree Height (cm)	Tree spread (cm) East-West	North-South
1	2	3	4	5	7
N_1 P_0	36.5	32.5	285.5	244.8	240.0
N_1 P_1	38.7	34.9	298.5	255.5	255.5
N_1 P_2	36.9	33.5	275.5	249.0	258.5

Contd...

1	2	3	4	5	6
N_2 P_0	35.3	31.1	270.5	239.5	255.5
N_2 P_1	33.4	31.3	257.0	226.5	234.5
N_2 P_2	36.6	33.2	293.4	257.5	246.0
N_3 P_0	35.8	33.6	292.0	269.0	246.5
N_3 P_1	34.4	31.0	264.5	244.5	247.5
N_3 P_2	35.9	32.3	266.0	231.5	247.5
N_4 P_0	33.4	31.5	278.0	228.5	247.5
N_4 P_1	36.4	33.5	287.0	254.5	254.5
N_4 P_2	37.9	34.3	288.0	241.0	246.5

Data = N S

Leaf Analysis

The leaf samples were collected in September, 1975 and its analysis for macro as well as micro-nutrients was under way.

**

H-1.3 (A) v : Micronutrient spray trial on sweet orange

M.S. Mann, M.S. Bajwa and S.K. Munshi

The experiment is aimed at to determine the efficacy of zinc spray alone and in combination with other nutrients in improving the health, yield and fruit quality in sweet orange (cv. Blood Red). NU-Sparton- a complete micronutrient mixture manufactured by Swati Industries Pvt. Ltd., Bombay — was also included to test and compare with other nutrient sprays.

There are nine treatments constituting sprays of $ZnSO_4$ alone and in combination with other nutrients, viz:

T_1 = Control (water spray)

T_2 = $ZnSo_4$ (0.5%)

T_3 = $ZnSo_4$ (0.5%) + $FeSo_4$ (0.1%)

T_4 = $ZnSo_4$ (0.5%) + $MgSo_4$ (0.1%)

T_5 = $ZnSo_4$ (0.5%) + $CuSo_4$ (0.1%)

T_6 = $ZnSo_4$ (0.5%) + $MnSo_4$ (0.1%)

T_7 = NU-Sperton (1.0%)

T_8 = NU-Sperton (2.0%)

T_9 = NU-Sperton (3.0%)

CAN (2 kg) and super phosphate (1 kg) are given as basal doses.

There are five replications having one tree unit under each replication in completely randomised block design. The time of sprays was April, June and August.

The sprays for the year 1975 were given as scheduled and the data were being recorded on the following aspects :

1- Leaf composition

2- Fruit drop

3- Fruit yield and quality

**

H-1.3 (BT) iii : Studies on the relationship of lime concentration and $CaCo_3$ contents in the soil with the vigour and micro-nutrient status in leaves of sweet orange

Jagdeyal Singh, M.S. Mann and P.S. Sarowa

Ten-year-old trees of sweet orange, variety Blood Red budded on rough lemon rootstock were selected in a local orchard at Bhatinda. Appraisal on each tree for its health was made according to four parameters on score card system as below :-

Parameter	Marks Allotted		
1- Size of the tree	Good (3)	Fair (2)	Poor (1)
2- Leaf density	"	"	"
3- General Health	"	"	"
4- Leaf chlorosis	"	"	"

On the basis of total marks obtained by each tree, they were grouped into 3 categories as below :

	Category	Total marks obtained
I	Healthy	8
II	Fair	5-8
III	Poor	5

Out of 108 trees scored as above 10 trees were selected from each category for collection of soil samples. Soil samples were taken from a distance of 120 cm away from the tree trunk with an auger at 0-15, 15-30, 30-60, 60-90, 90-120, 120-150 and 150-180 cm depths. Composite samples were drawn from four sites per tree. The soil samples were air dried, ground and sieved through 2 mm sieve to separate lime concretions greater than 2 mm dia. Soil pH was determined in 1 : 2 soil water suspension with Elico glass electrode pH meter and electrical conductivity of 1 : 2 soil water suspension was determined with the help of solubridge conductivity meter (U.S.D.A. Hand Book No. 60; Richard 1964). Calcium carbonate greater than 2 mm (free calcium carbonate) were determined by sieving and by Puri's (1949) method respectively.

Presence of lime concretion (Kenker) pan in sub-soil

Lime concretions (bigger than 2 mm dia.) in poor, fair and healthy category profiles varied from zero to 33.0 per cent, zero to

33.6 per cent and zero to 5.8 per cent respectively. The data in Table 20 show that in some of the profiles (especially in the poor category) the concretions were present in the form of massive layers at the depth of 150 cms. In all the profiles, concentration of lime concretions increased with depth. Kanwar et al. (1965) have fixed 20 per cent of lime concretions within the rootzone as the critical limit for the selection of area for citrus plantation. Based on this limit, 50 and 10 per cent profiles of poor and fair categories of citrus trees respectively can be rated as unfit whereas all the profiles in case of healthy category are fit for citrus plantation with respect to lime concretions. These observations suggest that presence of lime concretions is one of the main causes of poor health of citrus trees in the arid-irrigated areas.

Excessive Free Lime

Free calcium carbonate in the poor, fair and healthy category profiles varied from 0.8 to 11.3, 0.5 to 5.9 and 0.5 to 8.5 per cent respectively (Table 21). Earlier survey of citrus orchard soils in Punjab had shown that declining trees were generally associated with soils containing more than 5 per cent free lime in any of the horizons upto 180 cms depth; this was proposed as the critical limit. With accumulation of more data on physico-chemical characteristics of orchard soils the critical limit has been raised to 10 per cent. Based on the critical limit of 10 per cent, 30 per cent profiles are considered unfit in case of poor category and all the profiles in fair and healthy category were fit for citrus plantation. Taking 5 per cent free lime as the critical limit, 30 per cent profiles in poor and 30 per cent profiles in fair category can be declared as unfit whereas all the profiles in

healthy category are fit, for citrus plantation. These observations indicate that presence of excessive free lime is also an important factor in determining the suitability of soil for citrus plantation.

Soil reaction

Soil reaction as indicated by pH has a marked influence on soil environment, especially on the availability of plant nutrients. The pH of the soil in poor, fair and healthy category profiles varied from 7.9 to 9.0, 7.8 to 9.00 and 7.7 to 9.0 respectively (Table 22). On the basis of soil survey conducted by Kanwar et al. soil pH greater than 8.7 is considered as excessive for the growth of citrus. On the basis of this limit 70, 50 and 50 per cent soil profiles from poor, fair and healthy categories are unfit for citrus plantation. These results indicate that citrus continues to make apparently normal growth, even when pH is as high as 9.0.

Salinity hazard

The electrical conductivity of 1 : 2 soil water suspension in the present studies ranged between 0.12 to 0.45 mmhos./cm (Table 23). Kanwar and his associates (Kanwar and Randhawa, 1960; Kanwar et al. 1965) proposed that electrical conductivity of 1 : 2 soil water suspension should not be more than 0.5 mmhos./cm otherwise growth of citrus would be adversely affected. Therefore, salinity is no problem in this area.

Soil texture

In the present studies, soil texture was generally favourable for citrus cultivation. Soil texture ranged from loamy-sand to sandy-loam in 0 to 90 cm depth and sandy loam to loam in 90 to 180 cm depth (Table 24).

**

TABLE 20 : Lime concretions content in the soil profiles of poor, fair and healthy sweet orange trees

Tree No.	Category of tree health	Lime concentration (%) Depth (cm)						
		0-15	15-30	30-60	60-90	90-120	120-150	150-180
-	Poor	Nil	Nil	Nil	Nil	0.1	2.0	33.0
-	"	Nil	Nil	Nil	Nil	Nil	1.1	22.0
-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
-	"	Nil	Nil	Nil	Nil	Nil	0.8	21.0
-	"	Nil	Nil	Nil	Nil	0.1	2.0	23.0
0-	"	Nil	Nil	Nil	Nil	Nil	Nil	27.0
1-	Fair	Nil	Nil	Nil	Nil	0.1	1.0	7.1
2-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
3-	"	Nil	Nil	Nil	Nil	Nil	2.2	35.6
4-	"	Nil	Nil	Nil	Nil	Nil	2.1	4.1
5-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
6-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
8-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
9-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
20-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
1-	Healthy	Nil	Nil	Nil	Nil	Nil	3.6	3.8
-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
23-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
24-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
25-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
26-	"	Nil	Nil	Nil	Nil	Nil	1.1	0.1
27-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
28-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
29-	"	Nil	Nil	Nil	Nil	Nil	Nil	Nil
30-	"	Nil	Nil	Nil	Nil	Nil	Nil	3.0

TABLE 21 : Calcium carbonate content in soil profiles of poor, fair and healthy sweet orange trees

Tree No.	Category of tree health	Calcium carbonate % : Depth (cm)						
		0-15	15-30	30-60	60-90	90-120	120-150	150-180
1-	Poor	1.3	1.4	1.5	1.3	3.1	4.1	10.2
2-	"	1.3	1.7	1.6	1.0	2.0	1.8	1.7
3-	"	1.4	2.2	0.6	0.5	0.5	0.7	0.6
4-	"	3.0	3.5	2.6	2.2	7.6	9.3	11.3
5-	"	1.0	0.8	0.7	0.8	0.9	1.7	1.3
6-	"	1.0	1.2	1.5	0.8	0.5	1.1	1.4
7-	"	2.0	2.2	2.5	0.7	2.3	2.5	2.0
8-	"	0.9	2.2	2.2	2.1	1.2	0.5	1.5
9-	"	0.8	2.0	2.0	2.2	2.4	3.9	10.5
10-	"	1.0	0.9	0.8	1.3	1.5	1.3	1.5
11-	Fair	1.0	1.1	1.3	2.2	4.9	5.4	5.3
12-	"	1.2	1.5	1.4	1.3	1.3	1.4	1.3
13-	"	1.1	1.1	1.3	1.6	3.9	5.8	3.6
14-	"	1.7	1.5	2.1	3.2	4.6	5.9	3.5
15-	"	1.3	1.3	0.8	0.7	0.8	1.5	1.3
16-	"	2.1	1.8	0.5	1.1	1.2	2.0	1.7
17-	"	1.9	2.6	1.9	1.2	0.8	1.0	1.8
18-	"	0.6	1.3	0.5	0.8	1.0	1.0	1.0
19-	"	1.0	1.3	1.1	0.5	0.3	0.6	0.3
20-	"	1.9	1.7	1.3	1.0	1.0	1.5	1.0
21-	Healthy	1.4	1.5	1.3	1.9	1.2	1.5	1.3
22-	"	1.6	1.2	1.2	1.0	1.8	2.5	1.7
23-	"	1.8	1.2	1.0	1.2	1.2	1.5	1.3
24-	"	0.7	1.3	0.7	0.8	1.0	1.0	1.0
25-	"	1.2	1.3	0.7	1.7	1.6	1.5	1.3
26-	"	1.3	1.9	0.8	0.6	1.1	0.9	1.1
27-	"	1.7	1.9	1.8	1.2	1.7	0.8	1.0
28-	"	1.9	1.9	2.0	0.8	0.9	1.0	1.6
29-	"	1.7	1.2	1.4	1.3	1.5	1.2	1.0
30-	"	1.3	0.9	0.9	0.5	1.1	1.0	1.0

TABLE 22 : Soil pH in the soil profiles of poor, fair and healthy sweet orange trees

Tree No.	Category of tree health	pH Depth (cm) 0-15	15-30	30-60	60-90	90-120	120-150	150-180
1-	Poor	8.7	8.8	8.6	8.4	8.4	8.4	8.5
2	"	8.4	8.4	8.4	8.1	8.2	8.1	8.0
3-	"	8.7	8.7	8.6	8.7	8.7	8.8	8.9
4-	"	8.6	8.8	8.8	8.[illegible]	8.6	8.5	8.4
5-	"	7.9	8.1	8.1	8.2	8.0	8.1	8.3
6-	"	8.7	8.6	8.6	8.7	8.6	8.6	8.6
7-	"	8.7	8.7	9.0	9.0	9.0	9.0	8.6
8-	"	8.6	8.6	8.6	8.5	8.5	8.7	8.8
9-	"	8.7	8.7	8.8	8.8	8.9	8.9	8.9
10-	"	8.7	8.7	8.8	8.6	8.7	8.7	8.8
11-	Fair	8.9	9.0	8.7	8.6	8.6	8.6	8.6
12-	"	8.0	8.0	8.1	7.9	8.0	7.9	7.9
13-	"	8.5	8.6	8.6	8.5	8.6	8.6	8.8
14-	"	8.6	8.7	8.7	8.7	8.5	8.7	8.7
15-	"	8.5	8.3	8.3	7.9	8.0	7.9	7.8
16-	"	8.6	8.5	8.4	8.5	8.5	8.5	8.5
17-	"	8.3	8.4	8.4	8.4	8.5	8.5	8.5
18-	"	8.9	9.0	8.9	8.6	8.6	8.8	8.7
19-	"	8.6	8.8	8.5	8.5	8.6	8.8	8.7
20-	"	8.6	8.8	9.0	8.7	8.8	8.6	8.8
21-	Healthy	7.9	8.0	8.1	7.9	8.1	7.9	7.9
22-	"	8.4	8.3	8.4	8.4	8.4	8.7	8.5
23-	"	8.7	8.9	8.9	8.7	8.8	8.8	8.6
24-	"	8.1	8.1	8.2	8.4	8.3	8.2	8.2
25-	"	8.2	8.5	8.4	7.9	7.8	7.8	7.8
26-	"	8.5	8.7	8.8	8.8	8.7	8.9	8.8
27-	"	8.6	8.6	8.6	8.6	8.7	8.6	8.6
28-	"	8.7	8.9	8.7	8.6	8.7	8.8	8.9
29-	"	8.7	8.5	8.9	8.9	9.0	8.8	8.8
30-	"	8.7	8.9	9.0	8.7	8.6	8.7	8.8

TABLE 23 : Electrical conductivity of soil profiles in poor, fair and healthy sweet orange trees

Tree No.	Category of tree health	E.C. mhos/cms Depth 0-15	15-30	30-60	60-90	90-120	120-150	150-180
1-	Poor	0.30	0.27	0.36	0.33	0.33	0.36	0.24
2-	"	0.36	0.33	0.21	0.24	0.24	0.12	0.27
3-	"	0.18	0.18	0.24	0.24	0.12	0.15	0.09
4-	"	0.21	0.21	0.27	0.24	0.27	0.21	0.24
5-	"	0.21	0.15	0.24	0.24	0.24	0.24	0.18
6-	"	0.24	0.30	0.27	0.18	0.18	0.27	0.27
7-	"	0.21	0.21	0.18	0.18	0.15	0.15	0.18
8-	"	0.18	0.12	0.06	0.27	0.21	0.18	0.21
9-	"	0.18	0.18	0.23	0.22	0.11	0.14	0.10
10-	"	0.18	0.15	0.18	0.18	0.18	0.18	0.15
11-	Fair	0.14	0.30	0.33	0.39	0.36	0.27	0.27
12-	"	0.30	0.27	0.30	0.36	0.42	0.42	0.42
13-	"	0.45	0.21	0.33	0.30	0.24	0.21	0.18
14-	"	0.18	0.18	0.21	0.27	0.27	0.18	0.18
15-	"	0.30	0.33	0.27	0.39	0.45	0.42	0.42
16-	"	0.36	0.45	0.45	0.27	0.24	0.15	0.15
17-	"	0.18	0.27	0.27	0.15	0.21	0.21	0.21
18-	"	0.27	0.21	0.30	0.27	0.21	0.24	0.21
19-	"	0.30	0.21	0.30	0.30	0.21	0.27	0.15
20-	"	0.21	0.21	0.15	0.21	0.15	0.12	0.09
21-	Healthy	0.36	0.33	0.27	0.30	0.27	0.24	0.27
22-	"	0.42	0.36	0.36	0.36	0.36	0.24	0.30
23-	"	0.33	0.27	0.18	0.24	0.21	0.21	0.18
24-	"	0.19	0.20	0.20	0.16	0.20	0.20	0.14
25-	"	0.18	0.27	0.27	0.33	0.27	0.42	0.39
26-	"	0.21	0.30	0.31	0.24	0.21	0.18	0.18
27-	"	0.24	0.18	0.24	0.21	0.21	0.21	0.18
28-	"	0.21	0.15	0.21	0.24	0.18	0.15	0.12
29-	"	0.12	0.33	0.15	0.18	0.18	0.12	0.12
30-	"	0.18	0.18	0.15	0.18	0.12	0.15	0.15

TABLE 24 : Textural classes of soil profiles of poor, fair and healthy sweet orange trees

Tree No.	Category of tree health	Textural class Depth (cm)						
		0-15	15-30	30-60	60-90	90-120	120-150	150-180
1-	Poor	SL	LS	LS	SL	SL	SL	SL
2-	"	LS	LS	SL	SL	L	L	L
3-	"	LS	SL	SL	SL	L	L	L
4-	"	SL	LS	LS	LS	SL	SL	SL
5-	"	SL	SL	SL	SL	SL	SL	SL
6-	"	LS	LS	LS	SL	SL	SL	SL
7-	"	SL	SL	SL	SL	SL	L	L
8-	"	SL	SL	LS	SL	SL	SL	L
9-	"	SL	SL	LS	SL	L	L	L
10-	"	SL	SL	SL	LS	SL	L	L
11-	Fair	LS	LS	LS	SL	L	L	L
12-	"	SL	SL	LS	SL	SL	SL	LS
13-	"	LS	LS	LS	SL	SL	SL	SL
14-	"	SL	LS	LS	SL	SL	SL	L
15-	"	SL	SL	SL	SL	SL	L	L
16-	"	SL	LS	LS	SL	SL	L	L
17-	"	LS	LS	SL	SL	SL	SL	SL
18-	"	SL	LS	LS	SL	L	SL	L
19-	"	LS	LS	LS	SL	L	L	L
20-	"	LS	LS	LS	SL	L	L	L
21-	Healthy	LS	LS	SL	SL	SL	L	L
22-	"	SL	LS	LS	LS	SL	SL	SL
23-	"	SL	LS	LS	LS	SL	SL	SL
24-	"	SL	SL	SL	SL	SL	L	L
25-	"	SL	SL	LS	SL	SL	L	L
26-	"	SL	SL	LS	SL	SL	L	L
27-	"	LS	SL	SL	SL	SL	SL	SL
28-	"	LS	LS	LS	SL	L	L	SL
29-	"	LS	SL	SL	SL	L	L	L
30-	"	SL	SL	SL	SL	SL	L	L

LS = Loamy sand SL = Sandy loam L = Loam

H-1.3 (L) i : Effect of graded doses of nitrogen on the growth, yield and quality of sweet orange cv. Musambi

G.S. Nijjar, Gurcharan Singh and J.S. Arora

In order to find out the optimum dose of N for Musambi cultivar of sweet orange, a field trial was laid out in March, 1970 with the following experimental details :-

Treatments : Five doses of N
N_1 = 0, N_2 = 0.75 kg, N_3 = 1.00 kg
N_4 = 1.25 kg and N_5 = 1.50 kg/tree

Replications : 4

Tree Unit : 2

Experimental design : R B D

These are graded doses and shall be continued up to 1980.

The data on growth of trees and physico-chemical characters of fruits are presented in Table 25.

TABLE 25 : Effect of graded doses of nitrogen on griwth, yield and quality of Musambi cultivar of Sweet Orange

Treatment	Yield per tree		Fruit size			Physico-chemical characters				Trunk Dia (cm)
	No	Weight (kg)	Wt./ fruit (gm)	Length (cm)	Breadth (cm)	TSS (%)	Acidity (%)	Juice Wt. (g)	Leaf (N %)	
N_1	120	18.4	149.6	6.92	6.38	8.5	0.17	50.7	2.68	14.7
N_2	116	16.4	134.2	6.66	6.43	9.3	0.17	52.8	2.54	15.0
N_3	123	18.7	147.0	6.25	6.41	8.7	0.17	54.7	2.71	15.0
N_4	131	19.6	152.5	6.45	6.60	8.8	0.17	50.6	2.44	16.4
N_5	131	17.9	135.5	5.98	5.86	8.8	0.18	48.5	2.44	18.3

The results are non-significant

It is evident from the data in Table 25 that there was no significant difference in various attributes. The highest yield by weight (19.60 kg) and number (131) was recorded on the trees which were supplied with 1.25 kg of nitrogen per tree basis. Equal number of fruits were also recorded under 1.50 kg N treatment. Fruit size did not differ significantly under any of the treatments applied, however, highest fruit weight (152.57 g) was recorded on the trees which were supplied with 1.25 kg N per tree basis. The application of 1.00 kg N (per tree) increased the fruit juice to 54.70 gram. Highest T S S (9.3%) was recorded under No. 0.75 kg treatment whereas the application of 1.25 kg of N gave the highest acid contents (0.182%) in the fruits.

The diameter of the trunks of the trees did not differ significantly as the later are matured. However, the highest diameter (18.51 cm) was recorded under 1.50 kg N treatment, whereas the lowest trunk diameter (11.72 cm) was noted under control (NO treatment). Nitrogen contents of the leaves were in the optimum range (2.42 - 2.71 %). However, the highest leaf N (2.71%) was recorded on the trees, which were supplied with 1.00 kg N/tree.

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H-1.3 (L) ii : <u>Fertilizer trial on new citrus hybrids</u>

G.S. Nijjar, S.S. Gill and A.S. Sandhu

This trial was laid out during the year 1968 on five new citrus hybrids viz. Kinnow, Pearl, Milking, Darcy and Campbell Valencia. There are 27 treatment combinations of N, P and K and their doses are given below:-

N_1	= 150 gm, P_o	= 0 gm; K_o	= 0 gm	actual N, P_2O_5, K_2O
N_2	= 200 gm, P_1	= 150 gm; K_1	= 150 gm	per year age of
N_3	= 250 gm; P_2	= 200 gm, K_2	= 200 gm	the tree

The differential treatments were given to the trees during this year, the data recorded during the month of February,1975 (before the application of fertilizer) are presented here variety-wise.

1 KINNOW

Effect of N, P and K on Trunk diameter, height and spread of the tree

The diameter of the trunk of Kinnow trees was measured with the help of Caliper. The maximum average diameter (17.20 cm) was observed in treatment N_{150} P_{200} K_0 and it was followed by N_{200} P_{200} K_{200} with diameter 17.10 cm. The minimum trunk diameter (9.5 cm) was recorded in treatment N_{200} P_{200} K_0 (Table 26).

TABLE 26 : Effect of N, P and K combinations on trunk diameter, tree height and spread of Kinnow

Treatment	AVERAGE			
	Trunk diameter (cm)	Height (m)	Spread (m) E/W	Spread (m) N/S
1	2	3	4	5
N_{150} P_0 K_0	12.07	3.62	2.92	2.57
N_{150} P_0 K_{150}	12.80	3.10	2.60	2.80
N_{150} P_{200} K_0	17.20	2.80	2.80	3.00
N_{150} P_0 K_{200}	11.96	2.60	2.33	2.13
N_{150} P_{200} K_{150}	12.00	3.14	2.66	2.54
N_{150} P_{150} K_0	10.87	2.92	2.77	2.65
N_{150} P_{150} K_{150}	14.09	3.12	2.59	2.41
N_{150} P_{150} K_{200}	12.17	3.17	2.72	2.85
N_{150} P_{200} K_{200}	14.96	3.26	2.96	3.02
N_{200} P_0 K_{200}	16.11	3.36	2.78	2.88

Contd...

1	2	3	4	5
N_{200} P_{150} K_0	14.00	3.30	2.90	2.45
N_{200} P_{150} K_{200}	-	-	-	-
N_{200} P_{200} K_{200}	17.10	3.20	2.80	3.00
N_{200} P_0 K_{150}	14.20	3.60	3.10	3.15
N_{200} P_{200} K_0	9.55	2.45	1.80	1.80
N_{200} P_0 K_0	14.77	3.25	3.30	3.20
N_{200} P_{150} K_{150}	13.71	3.33	3.00	2.66
N_{200} P_{200} K_{150}	14.05	3.25	2.82	2.75
N_{250} P_{150} K_{200}	12.27	3.19	2.72	2.68
N_{250} P_{150} K_0	15.95	2.90	3.00	2.70
N_{250} P_{150} K_{150}	13.60	3.10	2.90	2.90
N_{250} P_0 K_{150}	16.70	3.50	3.40	3.10
N_{250} P_0 K_0	-	-	-	-
N_{250} P_{200} K_{150}	12.00	3.00	2.50	2.41
N_{250} P_{200} K_0	14.40	3.30	3.00	2.83
N_{250} P_{200} K_{200}	14.30	3.26	3.13	3.00
N_{250} P_0 K_{200}	16.15	3.30	3.15	3.30

As regard the height of the plant, the treatment N_{150} P_0 K_0 gave the maximum height (3.62 m) and the next best one was in the treatment $N_{200}P_0K_{150}$. The minimum height (2.45 m) was noticed in the treatment both ways i.e. East/West and North/South directions. The spread of the tree from East/West direction was maximum (3.30 m) in the treatment $N_{200}P_0K_0$. The next best was observed in the treatment $N_{250}P_0$ K_{200}. The minimum average spread of East/West direction was in $N_{200}P_{200}K_0$ treatment. The spread of North/South direction was maximum (3.30 m) in

$N_{250}P_0K_{200}$ treatment and the minimum was in the treatment $N_{200}P_{200}K_0$.

Combined effect of N, P and K on number of fruits, T S S and acidity of Kinnow plants

It is clear from the Table 27 that the highest yield by number of fruits were obtained from the trees which received $N_{150}P_{150}K_{200}$ treatment combination whereas, the lowest number of fruits were recorded in $N_{200}P_{200}K_0$ treatment.

Fruit quality data show that T S S percentage was highest (9.8%) recorded under $N_{150}P_0K_{50}$ treatment combination, the lowest was recorded (8.2%) in $N_{200}P_0K_0$ treatment.

The lowest acidity (0.74%) was recorded under the tree which were supplied with $N_{150}P_0K_{50}$ treatment combination.

TABLE 27 : Effect of N,P and K combinations on number and weight of fruit, T S S and Acidity of Kinnow juice

Treatment	Average			
	Number of fruits	Weight of fruits (gm)	T S S (%age)	Acidity (%age)
N_{150} P_0 K_{50}	29.5	48.50	9.8	.74
N_{150} P_0 K_{150}	132.5	60.10	9.5	.84
N_{150} P_{200} K_0	86.0	56.00	8.8	.87
N_{150} P_0 K_{200}	73.0	62.00	9.1	.81
N_{150} P_{200} K_{150}	138,0	52.00	8.4	.81
N_{150} P_{150} K_0	126.5	54.50	9.0	.85
N_{150} P_{150} K_{150}	31.0	41.00	9.0	.76
N_{150} P_{150} K_{200}	162.0	52.00	8.6	.87
N_{150} P_{200} K_{200}	134.5	53.55	9.0	.78
N_{200} P_0 K_{200}	65.3	55.50	9.0	.81

Contd...

1	2	3	4	5
N_{200} P_{150} K_0	86.0	50.00	9.0	.85
N_{200} P_{150} K_{200}	-	-	-	-
N_{200} P_{200} K_{200}	136.5	52.50	8.9	.84
N_{200} P_0 K_{150}	123.0	50.00	8.8	.86
N_{200} P_{200} K_0	29.0	44.50	8.6	.76
N_{200} P_0 K_0	86.0	52.00	8.2	.89
N_{200} P_{150} K_{150}	85.6	53.33	8.8	.77
N_{200} P_{200} K_{150}	75.5	54.25	8.9	.68
N_{250} P_{150} K_{200}	80.3	65.00	8.8	.87
N_{250} P_{150} K_0	95.5	53.50	8.3	.88
N_{250} P_{150} K_{150}	87.0	59.00	8.6	.87
N_{250} P_0 K_{150}	42.0	54.00	8.8	.85
N_{250} P_0 K_0	-	-	-	-
N_{250} P_{200} K_{150}	50.5	53.10	8.6	.86
N_{250} P_{200} K_0	79.0	55.73	8.7	.83
N_{250} P_{200} K_{200}	133.3	62.03	8.8	.86
N_{250} P_0 K_{200}	145.5	59.00	8.6	.87

2 MILKING

The treatment combinations of $N_2P_0K_2$ gave the thickest average diameter (10.42 cm), whereas the lowest was recorded under (7.64 cm) in $N_2P_2K_2$ treatment. The treatment in combination of $N_2P_1K_1$ gave maximum average height (2.80 m) (Table 28).

Treatment combination of $N_2P_0K_1$ recorded maximum number of fruits per tree. The highest T S S (9.30%) was obtained in the treatment

combinations $N_1P_2K_0$, the lowest acidity (0.71%) was recorded under $N_2P_2K_1$ treatment combinations.

3 CAMBELL VALENCIA

The maximum average diameter (12.26 cm) was recorded in the treatment combination $N_3P_2K_2$, whereas, the lowest (8.03 cm) was recorded under $N_1P_1K_1$ treatments. The treatment combinations $N_2P_0K_0$ gave the maximum average height (3.33 m).

$N_2P_2K_0$ gave (122.00) per tree. Maximum T S S (8.86%) was obtained under $N_1P_1K_1$ treatment. $N_1P_0K_0$ treatment combination recorded the lowest acidity 0.89% (Table-29).

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H-1.3 (L) iv : Survey to judge the nutrition status of citrus orchards in the Punjab

G.S. Nijjar, Satish Kumar and Ajit Singh

A survey was conducted of the citrus orchards of Abohar area this year. Seven prominent citrus orchards were surveyed and some 14 leaf samples of different cultivars of sweet orange were collected from these orchards. The leaf samples have been analysed for their N,P, K and S status and the data are presented in Table 30.

The leaf nitrogen was found to be in the range of 2.40 - 3.04 per cent which is in the satisfactory range as compared with standard values. Almost all of the orchards except Regional Fruit Research Station, Abohar are being intercropped with cotton or wheat. The cotton crop is being supplied with sufficient amount of nitrogenous fertilizers. Except in one or two orchards, the citrus trees are not being supplied with any nitrogen but whatever nitrogen is being supplied is either to the wheat

TABLE 28 : Combined effect of N, P and K on Average diameter, height, spread, weight, T S S and acidity of Vilking

Treatment	Av.diameter cm	Height m	Spread N/S (M)	Spread E/W (M)	No. of fruits	Wt.fruit	T.S.%age	Acidity %age
1	2	3	4	5	6	7	8	9
N_3 P_2 K_2	8.83	2.13	2.38	1.40	148	56.2	9.0	.74
N_3 P_0 K_2	8.02	2.33	1.81	1.91	179	53.5	8.7	.85
N_3 P_2 K_0	8.91	2.44	2.09	2.15	110	59.25	9.0	.75
N_3 P_0 K_0	8.19	2.46	2.14	2.07	183	58.80	9.06	.78
N_3 P_2 K_1	8.12	2.52	2.02	2.12	209	58.50	9.13	.73
N_3 P_0 K_1	7.86	2.43	1.97	1.7	214	61.10	9.0	.77
N_3 P_1 K_1	8.01	2.57	2.13	2.04	174	56.40	9.06	.72
N_3 P_1 K_2	8.96	2.45	2.17	2.13	167	55.20	9.06	.71
N_3 P_1 K_0	9.49	2.99	2.19	2.17	184	56.60	9.06	.75
N_2 P_2 K_1	8.59	2.52	1.96	2.09	232	56.9	9.2	.71
N_2 P_1 K_1	9.50	2.80	2.34	2.38	233	53.9	9.06	.76
N_2 P_0 K_2	9.15	2.49	2.13	2.30	189	56.8	9.27	.72
N_2 P_2 K_0	9.55	2.63	2.30	2.44	216	61.3	9.00	.75

Contd...

1	2	3	4	5	6	7	8	9
N_2 P_0 K_1	9.00	2.53	2.31	2.22	278	62.3	9.4	.77
N_2 P_2 K_2	7.64	2.63	2.13	2.13	224	55.8	8.9	.76
N_2 P_1 K_2	9.32	2.46	2.23	2.02	189	55.9	9.06	.74
N_2 P_1 K_0	8.34	2.44	2.14	1.86	249	57.9	9.06	.78
N_2 P_0 K_0	8.27	2.42	1.91	1.66	213	52.9	9.06	.73
N_1 P_2 K_2	8.67	2.43	2.12	1.64	239	56.5	8.93	.78
N_1 P_1 K_1	9.43	2.69	2.11	2.00	230	56.8	9.20	.75
N_1 P_1 K_0	10.42	2.39	2.49	1.53	246	59.05	9.20	.76
N_1 P_2 K_1	8.54	2.76	2.13	2.03	207	57.6	9.8	.72
N_1 P_0 K_2	8.53	2.51	1.90	1.86	251	57.4	9.9	.75
N_1 P_2 K_0	8.20	2.20	1.79	1.29	164	63.3	9.30	.73
N_1 P_0 K_1	8.72	2.46	2.09	2.13	236	61.8	9.13	.72
N_1 P_0 K_0	8.42	2.66	2.17	2.13	241	56.4	9.13	.76
N_1 P_1 K_2	8.92	2.53	1.97	2.02	211	55.5	8.9	.79

TABLE 29 : Combined effect of N, P and K on average diameter, height, spread, number of fruits, Wt. of fruit, T S S and acidity of Campbell Valencia

Treatment	Trunk Diameter	Height M	N S	E W	No. of fruits	Wt. of fruit (gm)	TSS %age	Acidity %age
1	2	3	4	5	6	7	8	9
N_1 P_0 K_1	9.61	2.72	2.55	2.44	81.33	136.03	8.40	0.96
N_1 P_0 K_0	8.84	2.94	2.68	2.67	100.66	130.26	8.66	0.89
N_1 P_1 K_0	7.94	3.16	2.65	2.54	102.33	125.43	8.33	0.99
N_1 P_1 K_1	8.03	2.85	3.29	2.96	97.33	124.56	8.86	0.90
N_1 P_1 K_2	8.22	2.95	2.45	2.48	100.33	129.50	8.46	0.96
N_1 P_2 K_0	8.17	2.82	2.52	2.29	95.00	127.90	8.73	0.91
N_1 P_2 K_1	8.79	2.80	2.90	2.62	103.00	126.50	8.53	0.99
N_1 P_0 K_2	8.14	3.01	2.89	2.81	88.33	131.46	8.46	0.91
N_1 P_2 K_2	8.22	2.96	2.52	2.34	86.66	135.13	8.46	0.91
N_2 P_0 K_2	8.29	3.03	2.59	2.59	80.66	135.43	8.73	0.95
N_2 P_1 K_0	11.30	3.31	3.00	2.78	124.00	135.33	8.46	0.94
N_2 P_0 K_0	9.27	3.33	3.18	2.85	100.33	140.33	8.46	0.94
N_2 P_1 K_2	10.27	3.19	2.98	2.61	108.66	138.73	8.66	0.93

Contd...

1	2	3	4	5	6	7	8	9
N_2 P_2 K_2	8.23	2.92	2.92	2.80	75.33	139.10	8.60	0.99
N_2 P_2 K_0	10.30	3.04	3.18	3.25	122.00	138.03	8.53	0.96
N_2 P_0 K_1	10.06	3.30	3.05	2.79	111.00	138.13	8.46	0.96
N_2 P_2 K_1	9.82	2.91	3.13	2.91	112.66	140.26	8.66	0.96
N_2 P_1 K_1	10.06	3.03	2.88	2.72	119.00	137.10	8.46	0.95
N_3 P_0 K_0	10.36	3.03	2.89	2.89	108.66	140.36	8.53	0.96
N_3 P_2 K_2	12.26	3.03	3.09	2.98	99.00	137.10	8.60	0.96
N_3 P_0 K_2	9.20	2.87	2.88	2.62	100.00	140.03	8.53	0.94
N_3 P_1 K_0	9.13	3.03	2.90	2.83	93.66	140.50	8.53	0.94
N_3 P_1 K_2	9.96	3.16	2.96	2.60	96.00	139.53	8.60	0.94
N_3 P_0 K_1	9.26	3.03	2.96	2.53	99.66	140.26	8.46	0.95
N_3 P_2 K_1	11.16	2.96	2.66	2.63	101.33	138.53	8.53	0.94
N_3 P_1 K_1	8.70	2.97	3.20	2.80	97.66	139.30	8.53	0.95
N_3 P_2 K_0	9.70	3.02	3.14	2.96	101.33	139.10	8.60	.95

TABLE 31 : Effect of N, P & K on growth, cropping and quality of Valencia Late

Treatment	Yield Fruit No.	Fruit size			Physico-Chemical Characters				Trunk dia (cm)
		Wt. per fruit(g)	Length (cm)	Breadth (cm)	T S S (%)	Acidity (%)	Juice Wt. per fruit (g)	Peel Wt. (g)	
1	2	3	4	5	6	7	8	9	10
N_1 P_1 K_1	88.0	124.1	6.46	6.48	9.2	0.84	54.2	28.5	14.6
N_1 P_1 K_2	84.6	121.0	6.41	6.50	10.2	0.88	52.4	30.2	16.4
N_1 P_1 K_3	93.6	124.6	6.37	5.76	11.1	1.06	55.2	31.2	17.6
N_1 P_2 K_1	74.6	111.6	5.59	5.48	10.3	0.92	48.8	27.8	15.3
N_1 P_2 K_2	125.0	115.7	6.54	6.24	8.7	0.92	51.4	28.6	14.4
N_1 P_2 K_3	143.0	134.6	6.40	6.46	10.0	1.10	58.3	33.6	17.7
N_1 P_3 K_1	114.6	158.6	7.41	6.54	10.6	1.09	63.4	37.7	15.5
N_1 P_3 K_2	99.0	116.3	6.93	5.70	10.4	1.00	50.8	29.5	17.7
N_1 P_3 K_3	113.0	107.5	6.26	6.14	11.3	0.96	46.8	27.2	17.6
N_2 P_1 K_1	74.0	103.3	5.03	4.90	10.9	1.06	44.6	26.2	15.8
N_2 P_1 K_2	76.0	132.5	6.30	6.52	10.8	1.08	57.9	33.7	15.3
N_2 P_1 K_3	142.0	104.8	5.25	5.05	11.4	1.06	42.3	27.0	16.7
N_2 P_2 K_1	91.6	119.8	6.44	6.32	11.2	1.15	52.8	30.4	14.6

1	2	3	4	5	6	7	8	9	10
N_2 P_2 K_2	128.3	124.5	6.13	5.95	11.2	0.92	53.5	29.9	18.0
N_2 P_2 K_3	95.3	105.4	5.71	5.59	10.3	1.10	45.6	28.9	14.6
N_2 P_3 K_1	114.3	116.3	5.91	5.90	10.3	1.00	48.3	29.6	14.5
N_2 P_3 K_2	174.3	133.8	6.71	6.42	10.4	1.05	57.1	33.4	18.1
N_2 P_3 K_3	88.6	120.6	6.85	6.33	10.4	1.12	52.1	30.8	15.6
N_3 P_1 K_1	80.6	109.8	5.61	5.27	11.4	1.22	47.2	27.9	16.9
N_3 P_1 K_2	70.3	102.8	5.48	5.61	10.6	0.87	45.1	26.3	16.8
N_3 P_1 K_3	101.0	129.5	6.12	6.50	10.4	0.96	53.9	31.7	16.4
N_3 P_2 K_1	98.6	125.1	5.77	5.38	11.4	1.18	54.1	34.4	13.6
N_3 P_2 K_2	55.6	130.3	6.26	6.01	10.7	1.09	52.3	33.3	12.7
N_3 P_2 K_3	115.3	120.6	6.53	6.37	11.6	0.99	52.5	31.3	16.1
N_3 P_3 K_1	153.3	127.0	6.13	5.90	11.0	0.99	54.4	32.0	16.2
N_3 P_3 K_2	109.3	134.5	6.13	6.06	11.2	0.94	58.2	33.8	19.2
N_3 P_3 K_3	101.0	128.5	6.29	6.15	11.6	1.09	55.3	32.8	16.7
C.D. at 5%	-	3.2	0.94	0.85	1.3	N S	N S	-	N S

or cotton crop which are sown as inter-crops in all the orchards. Citrus trees appear to be getting sufficient nitrogen for their growth and fruiting.

TABLE 30 : Nutritional status of citrus orchards of Abohar area (District Ferozepur)

Name and location of orchard	Cultivar	N	P	K	S
		(Per cent dry wt. trees)			
1- Ch. Raghbir Singh V & P O Katehra	Blood Red	3.00	0.22	1.65	0.30
	Musambi	3.00	0.21	1.80	0.29
2- Sh. T.S. Sandhu V & P O Ghallu	Blood Red	2.85	0.20	1.40	0.26
3- Ch. Atma Ram V & P O Dharampura	Blood Red	3.04	0.22	1.60	0.30
4- Sh. Kundan Lal Setia V & P O Sapanwali	Blood Red	2.85	0.18	1.60	0.25
	Musambi	2.85	0.19	1.30	0.23
	Jaffa	2.90	0.21	1.20	0.22
5- Ch. Prahlad Kumar Malout	Pineapple	2.90	0.19	1.60	0.28
6- Ch. Jagdish Kumar Malout	Blood Red	2.60	0.19	1.60	0.26
7- Regional Fruit Research Station, Abohar	Blood Red	2.85	0.15	1.55	0.20
	Musambi	3.00	0.13	1.65	0.22
	Jaffa	2.85	0.14	1.45	0.24
	Pineapple	2.40	0.12	1.62	0.26
	Valencia Late	2.40	0.12	1.60	0.24
Range	-	2.40 - 3.04	0.12 - 0.22	1.20 - 1.85	0.20 - 0.30
Chapman (1964)	-	2.20 - 2.70	0.12 - 0.18	1.20 - 1.70	0.20 - 0.30

The phosphorus in all the cultivars was found to be in the range of 0.12 - 0.22 per cent. Although all the samples were found to be in satisfactory range, the percentage of P in the samples collected from Regional Fruit Research Station, Abohar were just on the border line. It was observed that growth and fruting was very good in the orchards where phosphorus was applied to the tree. The fruit quality was also better and P percentage was the highest in these orchards.

Potassium in all the orchards was found to be in the range of 1.20 - 1.80. Although all the samples were in the normal range but no potassium is being applied at all to these orchards. The highest K_2O percentage (1.80) was in the orchard at serial No. 1. It was noticed that size of fruit in this orchard was bigger as compared with other orchards and there was no granulation specially in case of Musambi.

The sulphur was found to be in satisfactory range in all the orchards i.e. 0.20 - 0.30.

On the whole, the survey revealed that growth and yield were good in the orchards which were being looked after well and manured regularly. In case of orchards which were neglected the growth and yield were poor and trees were declining.

**

New Project : <u>Effect of N, P and K on growth, cropping and quality of Valencia Late cv. of Sweet Orange</u>

G.S. Nijjar and Gurcharan Singh

In order to find out the optimum doses of N, P and K for Valencia Late oranges, a fertilizer trial was initiated in March, 1975 with the following experimental details :-

Fertilizer doses (g/tree)

N	0.25	0.50	0.75
P_2O_5	0	0.25	0.50
K_2O	0	0.25	0.50
Treatment	27		
Replications	3		
Plant Unit	1		
Experimental Design	R B D		

Treatment Combinations

N_1	P_1	K_1	250	0	0
N_1	P_1	K_2	250	0	250
N_1	P_1	K_3	250	0	500
N_1	P_2	K_1	250	250	0
N_1	P_2	K_2	250	250	250
N_1	P_2	K_3	250	250	250
N_1	P_3	K_1	250	500	0
N_1	P_3	K_2	250	500	250
N_1	P_3	K_3	250	500	500
N_2	P_1	K_1	500	0	0
N_2	P_1	K_2	500	0	250
N_2	P_1	K_3	500	0	500
N_2	P_2	K_1	500	250	0
N_2	P_2	K_2	500	250	250
N_2	P_2	K_3	500	250	500
N_2	P_3	K_1	500	500	0
N_2	P_3	K_2	500	500	250
N_2	P_3	K_3	500	500	500
N_3	P_1	K_1	750	0	0
N_3	P_1	K_2	750	0	250
N_3	P_1	K_3	750	0	500
N_3	P_2	K_1	750	250	0
N_3	P_2	K_2	750	250	250
N_3	P_2	K_3	750	250	500

Contd...

N_3	P_3	K_1	750	500	0
N_3	P_3	K_2	750	500	250
N_3	P_3	K_3	750	500	500
			....		

The data recorded are given in the Table 31. Highest yield per tree (174.3 fruits) were obtained when $N_2 P_3 K_2$ treatment was applied. The highest fruit weight (158.6 g) and size (7.41 x 6.54 cm) were recorded when $N_1P_3K_1$ treatment was given. Fruit wt. was highly significant over all the treatments when $N_1P_3K_1$ treatment was given. Highest T S S (11.6%) was recorded from the trees which were applied with highest level of the fertilizer dose ($N_3P_3K_3$) and it differed significantly over $N_1P_1K_1$, $N_1P_1K_2$, $N_1P_2K_1$, $N_1P_2K_2$, $N_1P_2K_3$, $N_2P_2K_3$ and $N_2P_3K_1$ treatment. Treatment $N_3P_2K_1$ gave the highest acidity (1.18 %). There was no significant increase in the peel and juice weight. As the trees are mature the diameter (growth) of the trunk did not increase significantly. The largest tree diameter (19.2 cm) was recorded under $N_3P_3K_2$ treatment.

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New Project : <u>Effect of graded doses of N, P and K on growth yield and quality of sweet orange cv. Jaffa</u>

To find out suitable economic dose of N, P & K for sweet orange a field trial was started in January, 1975 on Jaffa trees planted in August, 1965. Since plants have attained mature age, the following doses of N P & K will be applied every year. The experimental details are :-

Experimental design	=	Completely Randomised Design
No. of replications	=	Three
No. of plant Unit	=	One
No. of treatments	=	27
i) N	=	400, 800 & 1200 g per tree
ii) P	=	0, 200 & 400 g per tree
iii) K	=	0, 200 & 400 g per tree
No. of experimental trees	=	27 x 3 = 81

During the year, fruit quality data were recorded in December, 1975 tree growth data in January, 1976 and fertilizers were applied in February, 1976.

The data given in Table 32 show that different levels of N, P and K did not show any significant differences with regard to trunk girth, tree height and spread. However, the highest trunk girth (55.0 cm) was obtained under $N_1P_2K_2$ & $N_1P_2K_1$ treatment, the greatest tree height (3.50 m) under $N_2P_1K_0$ treatment and the highest tree spread (5.66 m) under $N_3P_0K_1$ treatment.

The data given in Table 33 show that there were no significant differences in average fruit weight and acidity under different treatments. However, the highest average fruit weight (187.3 g) was obtained under $N_1P_0K_1$ and the lowest (147.3 g) under $N_1P_2K_2$ treatments.

The treatments $N_3P_0K_0$, $N_3P_2K_0$, $N_1P_1K_2$, $N_2P_0K_1$, $N_2P_0K_2$, $N_1P_2K_2$, $N_2P_2K_1$ and $N_2P_1K_1$ gave significantly higher T S S per cent over other treatments. The acidity was the highest (0.89 %) under $N_3P_0K_1$ and the lowest (0.60%) under $N_1P_2K_2$ treatments.

**

TABLE 32 : Effect of graded doses of NPK on trunk girth and height and spread of Sweet orange trees cv. Jaffa

Treatments	Trunk girth (cm)	Tree height (m)	Tree spread (m)
N_1 P_0 K_0	47.3	3.16	4.36
N_1 P_1 K_0	50.6	3.23	4.53
N_1 P_2 K_0	51.6	3.30	4.50
N_2 P_0 K_0	48.6	3.[illegible]3	4.73
N_2 P_1 K_0	51.3	3.50	4.56
N_2 P_2 K_0	43.3	3.30	4.43
N_3 P_0 K_0	47.0	3.36	4.73
N_3 P_1 K_0	48.3	3.43	4.73
N_3 P_2 K_0	50.0	3.26	4.60
N_1 P_1 K_2	55.0	3.36	4.66
N_1 P_0 K_1	52.0	3.43	4.86
N_1 P_0 K_2	51.0	3.40	4.63
N_2 P_1 K_2	48.0	3.33	4.10
N_2 P_0 K_1	50.0	3.46	4.60
N_2 P_0 K_2	45.6	3.16	4.20
N_3 P_1 K_2	53.0	3.46	4.70
N_3 P_0 K_1	51.0	3.36	5.06
N_3 P_0 K_2	49.3	3.26	4.66
N_1 P_2 K_1	55.0	3.40	4.76
N_1 P_1 K_1	49.3	3.36	4.73
N_1 P_2 K_2	43.3	3.33	4.30
N_2 P_2 K_1	52.0	[illegible]	[illegible]
N_2 P_1 K_1	51.6	3.36	4.53
N_2 P_2 K_2	49.0	3.36	4.60
N_3 P_2 K_1	52.6	3.30	4.50
N_3 P_1 K_1	45.6	3.26	4.40
N_3 P_2 K_2	44.6	3.36	4.66
C.D. at 5%	N S	N S	N S

TABLE 33 : Effect of graded doses of N P K on the av. fruit weight , T S S and acidity of Sweet Orange cv. Jaffa

Treatments	Av. fruit weight (gm)	T S S (%)	Acidity (%)
N_1 P_0 K_0	159.0	6.7	0.67
N_1 P_1 K_0	162.6	7.1	0.67
N_1 P_2 K_0	169.0	7.2	0.65
N_2 P_0 K_0	167.0	6.8	0.76
N_2 P_1 K_0	169.6	7.2	9.64
N_2 P_2 K_0	174.0	7.2	0.70
N_3 P_0 K_0	175.0	7.4	0.66
N_3 P_1 K_0	159.6	6.7	0.69
N_3 P_2 K_0	152.0	7.5	0.62
N_1 P_1 K_2	150.6	7.7	0.71
N_1 P_0 K_1	187.3	7.1	0.68
N_1 P_0 K_2	153.3	7.2	0.63
N_2 P_1 K_2	153.3	7.5	0.67
N_2 P_0 K_1	160.6	7.9	0.64
N_2 P_0 K_2	177.6	7.5	0.64
N_3 P_1 K_2	165.3	7.2	0.78
N_3 P_0 K_1	171.0	7.0	0.89
N_3 P_0 K_2	165.0	7.3	0.67
N_1 P_2 K_1	164.0	7.0	0.63
N_1 P_1 K_1	168.6	7.0	0.86
N_1 P_2 K_2	147.3	7.9	0.60
N_2 P_2 K_1	168.6	7.3	0.71
N_2 P_1 K_1	165.0	7.3	0.71
N_2 P_2 K_2	173.6	6.7	0.65
N_3 P_2 K_1	156.6	7.1	0.66
N_3 P_1 K_1	179.6	7.1	0.64
N_3 P_2 K_2	158.0	7.0	0.69
C.D. at 5%	N S	0.63	N S

H-1.6 (BT) ii : To study efficacy of different weedicides in citrus orchards

Jagdayal Singh and N.S. Tomer

In order to study the efficacy of two herbicides namely Gesatop and Caragard on control of weeds in Musambi, a trial was laid out at village Badal (Faridkot) during December, 1974 with the following details :-

Variety	:	Musambi
Treatments	:	Seven, viz. Gesatop 3, 4 & 5 kg a.i./ha Caragard 3,4 & 5 kg a.i./ha and control
Replications	:	Three
Plant Unit	:	One
No. of experimental plants	:	7 x 3 x 1 = 21
Spacing	:	7 x 7 m
Design	:	R B D

Data on the density of monocot and dicot weeds were collected 90 days after the application of treatments and average number of weeds and their dry weight were calculated on per square meter basis which are presented in Table No. 34.

a) Effect on monocot weed species

All the treatments of herbicides were statistically ineffective in controlling the two weed species, i.e. Baru (Sorghum halepense) and Khabbal (Cynodon dactylon). The density of the two other monocot species viz. Sitawala ghas (Polygopon monospeliensis) and wild grass (Phalaris minor) was found to be nil in the treated plots.

The dry matter of Baru (Sorghum halepense) and Khabbal (Cynodon

TABLE 34 : The effect of different treatments of Gesatop and Caragard on density and dry matter of monocot weed species

Treatment	Rate Kg a.i./ ha.	Monocot weeds/m^2				Cyperus rotundus/ m^2	Dry matter of monocot weed species in gm/m
		Sorghum halepense	Cynodon dactylon	Polygopon monospeti-cnsis	Phalaris minor		
Gesatop	3	14.51	4.69	0.00	0.00	5.33	6.68
-do-	4	14.19	10.75	0.00	0.00	4.27	9.41
-do-	5	13.87	7.04	0.00	0.00	1.07	9.00
Caragard	3	21.17	7.89	0.00	0.00	7.89	7.98
-do-	4	15.57	11.45	0.00	0.00	4.25	10.80
-do-	5	13.01	5.33	0.00	0.00	3.20	9.80
Control	-	11.73	2.13	1.28	0.21	0.00	38.05
C.D. at 5%		N S	N S	-	-	-	9.52

dactylon) weeds was found to be significantly reduced by all the herbicidal treatments.

b) Effect on dicot weed species

A perusal of the data given in Table 35 reveals that the dicot weeds, viz. Jangali Palak (Rumex acutus), Pilisenji (Heliolotus indica), Krishan neel (Anagallis arvensis), Bathu (Chenopodium album) and Maina (Medicago denticulata) were completely checked by all the treatments. The density of Kantiari (Carthamus oxyacantha) and Hiran Khuri (convolvulus arvensis) was reduced by the application of these herbicides.

The dry matter of dicot weeds was significantly reduced by these treatments.

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H-1.8 (L) i : Studies on storage life of Kinnow

S.S. Mann, B.S. Dhillon and
J.S. Randhawa

With a view to prolong the storage, the Kinnow fruits were harvested each on 19.1.76, 8.2.76, 18.2.76 and 5.3.76 and cold stored at a temperature of 0 - 3.3°C and relative humidity 85 - 90 per cent after the following treatments :-

T_0 = Control (kept open in wooden crates)

T_1 = Kept in polythene bags

T_2 = Treated with wax emulsion (6%) and packed in polythene bags

T_3 = Treated with 2, 4, 5 - T(100 ppm) + wax (6%) and packed in polythene bags

T_4 = Treated with 2, 4, 5-T (200 ppm) + wax (6%) and packed in polythene bags

TABLE 35 : The effect of different treatments of Gesatop and Caragard on density and dry matter of dicot weed species

Treatment	Rate Kg a.i./ ha.	Dicot weeds/m^2							Dry matter in gm/m^2
		Carthamus oxyacantha	Convolvulus arvensis	Rumex acutus	Melio lotus indica	Anaga-llis arven-sis	Chono-podium album	Medi cago denti-culata	
Gesatop	3	0.067	0.040	0.00	0.00	0.00	0.00	0.00	0.73
-do-	4	0.067	0.093	0.00	0.00	0.00	0.00	0.00	0.113
-do-	5	0.053	0.053	0.00	0.00	0.00	0.00	0.00	0.038
Caragard	3	1.107	0.067	0.00	0.00	0.00	0.00	0.00	0.185
-do-	4	0.093	0.160	0.00	0.00	0.00	0.00	0.00	0.158
-do-	5	0.027	0.027	0.00	0.00	0.00	0.00	0.00	0.021
Control	-	1.320	0.280	26.24	0.42	16.64	6.83	39.68	0.582
C.D. at 5%	-	0.766	N S	-	-	-	-	-	0.21

Polythene bags used were of 200 gauge thickness.

The fruit samples were taken out of the cold storage after 50, 80 and 100 days for the first 3 dates of harvest while after 50, 70 and 90 days for 4th harvest.

The data on general appearance, weight loss, spoilage and chemical composition were recorded on each sampling date. The values based on duplicate estimations have been presented in the Table 36 for the total storage life.

The general appearance of the fruits harvested on 18.2.76 was good than the fruits harvested on other dates throughout the period of cold storage.

The fruits kept in polythene bags after or without any further treatment experienced markedly less loss in weight than the control. In general, the spoilage was more than economical level in the fruits under all the treatments and for all the date of harvest except for T_2 treatm in which the spoilage was less in fruits of first three harvest but in fruits of 4th harvest, this treatment did not effect spoilage to a marked extent than other treatments. The spoilage during storage follo a ascending order with the advanced dates of harvest.

The chemical composition of fruits in respect of T S S, acidit and total sugars did not very much under various treatments. However, general, the T S S increased and the acidity decreased in fruits harves on 18.2.76 and 5.3.76 than earlier harvests.

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TABLE 36 : Effect of various treatments on weight loss, spoilage and chemical composition of Kinnow fruits during storage

Part I

SAMPLING DATES

Treatment	19.1.1976 Spoilage %	Wt. Loss %	TSS %	Acidity %	Total sugars %	Vit. C mg/100 gm of juice	3.2.1976 Spoilage %	Wt. Loss %	TSS %	Acidity %	Total sugars %	Vit. C
T_0	5.61	13.4	13.0	.68	7.2	21.4	20.0	16.5	12.8	.62	6.4	17.9
T_1	22.0	4.6	4.3	.59	6.6	18.8	22.2	3.5	11.6	.60	6.3	17.9
T_2	0.0	1.0	11.7	.66	6.3	20.8	11.0	2.0	11.6	.61	6.5	17.3
T_3	11.0	3.5	11.4	.63	6.4	20.7	11.0	2.1	11.1	.59	6.9	16.9
T_4	5.5	1.0	11.1	.66	6.8	19.7	16.7	1.8	11.1	.62	6.6	17.2

Part II

Treatment	18.2.1976 Spoilage %	Wt. Loss %	TSS %	Acidity %	Total sugars %	Vit. C mg/100 gm of juice	5.3.1976 Spoilage %	Wt. Loss %	TSS %	Acidity %	Total sugars %	Vit. C
T_0	44.5	19.9	14.5	.69	8.1	18.1	54.8	21.6	14.5	.59	8.8	14.6
T_1	38.8	3.7	12,1	.48	7.0	17.9	50.0	2.6	11.7	.59	7.7	14.0
T_2	21.3	2.1	12.0	.51	6.9	16.8	51.7	1.4	11.3	.52	6.8	13.6
T_3	38.8	1.9	11.5	.52	7.8	17.4	51.9	2.3	11.6	.51	7.8	13.6
T_4	16.6	1.4	12.0	.56	8.6	17.8	49.6	2.6	12.1	.56	7.6	13.7

H-1.10 (L) i : Evaluation of nucellar trees of sweet orange in the field

S.P. Kapur, R.S. Dhillon and S.A. Ananda

Five year old nucellar seedlings of five commercial cultivars of sweet orange, namely Blood Red, Musambi, Jaffa, Valencia and Pineapp planted in the field at a distance of 3 m x 3 m were given recommended cultural practices including manuring and plant protection measures. Th were kept under observation for evaluating their performance. This yea two nucellar trees each of Blood Red, Musambi and Valencia cultivars ca into bearing for the first time. The maximum number of fruits per tree (37 fruits) were borne by Blood Red. The quality of fruits will be assessed when they ripen. Three nucellars from each cultivar were chemically indexed for greening virus but none of them was found to be greening positive.

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H-1.10 (L) ii : Incidence and rate of spread of citrus decline

R.S. Dhillon, S.P. Kapur and S.A. Ananda

The plant material comprising nucellar Blood Red and Nucellar Musambi raised on nucellar Rough Lemon rootstock was ready for planting in the field. This material will be utilised to study the incidence a rate of spread of citrus declime.

The main objective of the trial is to find out the period required for the onset of tree decline in the two cultivars under field conditions. The role played by nucellar Rough Lemon rootstock, if any, in the sweet orange tree decline would also be looked into. The trees

would be given recommended cultural inputs and data would be recorded on growth parameters, such as stock and scion girth, height and spread of the trees and the incidence of citrus diseases and viruses.

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H-1.10 (L) iii : Indexing of citrus viruses

S.P. Kapur, R.S. Dhillon, S.S. Cheema,
Shashi Kapur and S.K. Kapur

A good deal of work under this project was done. A brief resume is given below :-

1- Prevalence of greening disease in different species of citrus

Trees of 43 species/cultivars of citrus from the citrus collection block at Regional Fruit Research Station, Abohar were screened for the presence of greening marker substance with a view to find out the incidence of greening infection in different species and cultivars of citrus. The results of T L C (Thin layer chromatography) analysis are presented in Table 37.

TABLE 37 : Prevalence of Greening Marker in different species/cultivars of citrus

Species	No. of trees tested	No. of trees positive	Incidence of greening marker (%)
1	2	3	4
Sweet Oranges			
1- Campbell Valencia	4	3	75
2- Madam Vinous	2	2	100
3- Limo Orange	2	2	100
4- Olinda Valencia	2	2	100
5- Orange of Heaven	2	2	100

Contd....

1	2	3	4
Mandarins			
1- Clementino	1	1	100
2- Cleopatra	4	4	100
3- Coorg	1	1	100
4- Dancy	4	3	75
5- Honey	3	3	100
6- Kara	2	2	100
7- King	2	2	100
8- Kinnow	4	2	50
9- Swato	2	2	100
10- Wilking	4	2	50
Tangelos			
1- Minneola	4	4	100
2- Orlando	3	3	100
3- Pearl	4	3	75
4- Sampson	3	3	100
Rough Lemon			
1- Florida Rough Lemon	2	0	0
2- Jatti Khatti	2	2	100
3- Jullunduri Khatti	2	2	100
4- Jambhiri	2	2	100
Trifoliate Orange and Hybrids			
1- Rubidoux	4	2	50
2- Citrumelo	4	4	100
3- Swingle citrumelo	2	1	50
4- Carrizo citrange	4	1	50
5- Savage citrange	2	1	50
6- Troyer citrange	2	1	50
Miscellaneous			
1- Calamondin	2	1	50.
2- Chinotto	2	2	100
3- Citron	1	1	100
4- C. macroptera	1	1	100
5- C. macrophylla	1	1	100
6- C. taiwanica	2	2	100
7- Amlbad	1	0	0
8- Gajanimmo	3	0	0
9- Kharna Khatta	2	0	0
10- Pectiniferа	2	2	100
11- Nasnaran	2	2	100
12- Sadaphal	2	1	50
13- Severinia buxifolia	2	1	50
14- Rangpur Lime	2	2	100

It is evident from the data that almost all the species/ cultivars showed the presence of greening marker substance to a very high degree. Out of the 43 species/cultivars tested, only four, viz. Florida Rough Lemon, Amlbod, Gajanimma and Kharna Khatta were found free from greening marker substance and hence free of greening infection.

2- Effect of different rootstocks on the incidence of greening

Blood Red sweet orange plants on seven different rootstocks, viz. Jatti Khatti, Kharna Khatta, Troyer, Carrizo, Cleopatra, Citrumelo and Poctinifera as well as Nucellar Blood Red seedlings were indexed chromatographically to find out the effect of different rootstocks on the incidence of greening.

Results available so far show that Blood Red, which is highly susceptible to greening, was found cent per cent infected with the disease on all the rootstocks. However, the incidence of the disease was observed to the extent of 25 per cent only in Nucellar Blood Red trees raised on their own roots.

3- New Viruses

a) Leaf curl virus : Surveys carried out in the State to establish the presence of new viruses, revealed the presence of citrus trees showing symptoms resembling leaf curl virus in the orchard of Sh. Atma Ram of Dharampura (Abohar). Indexing of these trees through graft transmission tests on various indicator plants was, therefore, carried out in the screen-houses at Ludhiana. No reaction has been observed so far in any of the indicator plants. This work would be repeated again during next budding season to arrive at definite conclusions.

b) Satsuma dwarf virus : Some trees of Kinnow mandarin were observed to show a typical downward curling of leaves, which seemed to

resemble the symptoms of 'satsuma dwarf virus'. Transmission tests were, therefore, carried out through sap inoculations on Sesamium inidicum L., indicator of satsuma dwarf virus. Sesamium indicum plants did not react the way they are supposed to react with satsuma dwarf infections, but certain other abnormalities were observed on the leaves of the indicator plants, viz. appearance of water soaked local lesions, turning of dark brown spots later on. Some plants, however, did not show the local lesio but instead showed certain systemic infections in which the full grown leaves became coarse and puckered with rust coloured intervenial chlorosi which started from the leaf tips and extended along the leaf margins. Ultimately curling of the leaves was noticed in the infected sesame plan The new emerging leaves were found to show dwarfing and distortion. Our studies reveal that the factor responsible for the afore-mentioned abnormalities is sap-transmitted. Further studies are currently underwa to establish the identity of this factor.

**

H-1.10 (L) iv : Certification, inspection and registration of virus free citrus trees

S.P. Kapur, S.S. Cheema, R.S. Dhillon,
Shashi Kapur and S.K. Kapur

a) Selection of Candidate trees and Indexing

More citrus orchards around Abohar, Ludhiana and Attari were surveyed and 27 citrus candidate trees (Jaffa-5, Acc Nos. 375-379 ; Musambi-20, Acc Nos. 380-392 and 398-404; Baramasi Nimbu-1, Acc No. 396 and Blood Red-1, Acc No. 397) were selected and indexed chromatographica for greening mycoplasma. Location of the candidate trees and the result

of chromatographic indexing are presented in Table 38. Of the 27 trees indexed chromatographically, 3 trees of Musambi (Acc Nos. 399, 400 and 402) and one tree of Baramasi Nimbu (Acc No. 396) were found free from the greening disease. The remaining trees being greening positive were rejected. The greening free Baramasi Nimbu was further indexed for Tristeza, Exocortis and Psorosis viruses whereas the Musambi trees are currently being indexed for these viruses. Final results would be available in due course.

b) Supply of virus free Budwood

A total of 980 virus-free buds (Valencia-30, Musambi-30, Dancy-230, Kinnow-350, UCLA Eureka lemon-20, Frost Eureka lemon-20, Red Blush grape-fruit-10, Marsh Seedless grapefruit-20 and Orlando tangelo-20) were supplied to various research stations of the University during the year. Ten virus-free buds each of Blood Red, Musambi, Jaffa, Atwood Early Naval, Cutter Valencia, Parent Naval, Pineapple, Sanguinella Blood, Skogg's Naval, Torroco Blood, Trivita orange, Jumer, Queen, Salustiana and Campbell Valencia sweet oranges were supplied to Dr. K. Ramakrishnan, Dean, University of Agricultural Sciences, Hebbal, Bangalore. In addition 10 buds each of Valencia, Musambi and Pineapple sweet oranges, Dancy and Kinnow mandarins, Frost Eureka and UCLA Eureka Lemon, Marsh Seedless and Red Blush grapefruit and Orlando tangelo were given to Dr. K.C. Srivastava, Senior Horticulturist, Citrus Experiment Station, Gonicoppal, Karnataka.

c) Propagation of Swingle Citrumelo :

Propagative material both seeds and budwood of Swingle Citrumelo, which is reported to be resistant to most of the components of citrus die-back, was imported from California, USA and propagated inside the screen-houses at Ludhiana.

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TABLE 38 : Results of chromatographic indexing for greening of candidate trees selected and indexed during the report period

S.No.	ACC No.	Name of cultivar	Location	Results of chemical indexing for greening	Date of indexing
			Satia Orchard, Sapparwali		
1-	375	Jaffa	Block B, Row 1, Plant 4	+	8.4.1975
2-	376	"	Block B, Row 1, Plant 12	+	"
3-	377	"	Row 4, Plant 13	+	"
4-	378	"	Row 4, Plant 12	+	"
5-	379	"	Row 4, Plant 10	+	"
6-	380	Musambi	Block A, Row 1, Plant 12	+	"
7-	381	"	Row 1, Plant 5	+	"
8-	382	"	Row 1, Plant 4	+	"
9-	383	"	Row 4, Plant 9	+	"
10-	384	"	Row 2, Plant 13	+	"
			Rai Sahib Kundan Lal Orchard, Khuban		
11-	385	"	Row 26, Plant 1	+	1.8.1976
12-	386	"	Row 6, Plant 2	+	"
13-	387	"	Row 14, Plant 1	+	"
14-	388	"	Row 6, Plant 3	+	"
15-	389	"	Row 6, Plant 10	+	"
16-	390	"	Row 2, Plant 5	+	"
17-	391	"	Row 1, Plant 3	+	"
18-	392	"	Row 1, Plant 2	+	"
19-	396	Baramasi Nimbu	Model Town, Ludhiana	-	2.9.1975
20-	397	Blood Red	Govt. Agri. Farm, Attari (New Block)	Not available	
21-	398	Musambi	"	"	
			Ch. Balram Orchard, Mauzgarh (Abohar)		
22-	399	"	Row 6, Plant 5	-	
23-	400	"	Row 9, Plant 6	-	
24-	401	"	Row 9, Plant 13	+	
25-	402	"	Row 20, Plant 12	-	
26-	403	"	Row 21, Plant 15	+	
27-	404	"	Row 22, Plant 15	+	

H-1.10 (L) v : Studies on styler-end and stalk-end rot of citrus fruits

S.S. Cheema, S.P. Kapur and Shashi Kapur

Pure cultures of Colletotrichum gloeosporioides and Alternaria citri - causal organisms of stalk-end rot and styler-end rot respectively were grown on P D A. Fruits of two sweet orange cultivars namely Blood Red and Pineapple were surface sterilised with 95 per cent alcohol and then inoculated with uniform bits (5 mm) from each culture. Rotten fruits were analysed for sugars and amino acids. Results revealed that both pathogens reduced the level of sucrose and glucose and most of the amino acids (Table 39 & 40). However, Alternaria infection increased cysteine + cystine, Glutamic acid, L - alanine + valine and methionine. The level of arginine remained unchanged and Butyric acid accumulated.

TABLE 39 : Effect of Alternaria citri and Colletotrichum gloeosporioides infection on sugars in Blood Red Sweet orange

Sugars	Healthy B.R.	Alternaria infected B.R.	% Reduction/ increase	Colletotrichum Infected Blood Red	% Reduction/ increase
Total Soluble Solids %	10.5	6.83	34.9	7.5	28.60
Reducing sigars %	6.13	3.66	40.3	3.4	44.50
Sucrose mg/g of fruit tissue	13.60	10.20	25.00	0.80	92.90
Glucose/mg/g of fruit tissue	8.15	6.15	24.5	0.80	90.20
Fructose mg/g of fruit tissue	3.50	3.40	2.9	1.70	51.40

TABLE 40 : Effect of Alternaria citri and Colletotrichum glocosporioides infection on amino acids ug/1 g of tissue in Blood Red Sweet orange

Amino Acids	Healthy B.R.	Alternaria infected B.R.	% Reduction/ Increase	Colletotrichum infected B.R.	% Reduction Increase
Cysteine + Cystine	40	80	100.0	20	50.C
Glutamic acid	100	110	10.00	30	70.0
Aspartic acid	800	700	12.33	60	92.5
Glycine + Serine	200	90	55.00	30	85.0
L.- alanine	110	140	30.00	50	54.5
Threonine	70	50	28.56	10	85.7
Tyrosine	190	50	72.80	60	68.4
Arginine	30	30	-	30	0
ramino-butyric acid	-	20	200.00*	-	0
Valine + methionine	30	40	33.3	-	100.00

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H-1.10 (L) vi : Studies on the relationship between greening disease of citrus and its vector

S.S. Cheema, S.P. Kapur and S.K. Kapur

Different species/cultivars of citrus growing at the Regional Fruit Research Station, Abohar were screened against greening mycoplasma and its vector citrus psylla. Results revealed a positive correlation between the vector and the incidence of greening (Table 41).

The population level of psylla was zero on Amlibed and Pomeri. It was considerably lower and ranged from 0-10 nymph per twig in species

TABLE 41 : Incidence of Greening and citrus psylla on different cultivars/ species of Citrus

Cultivar/Species	Resistant (No Nymph) Cultivar	Greening % age	Commercially Resistant (Nymph 0-10/twig) Cultivar	Greening %	Mildly (nymph 10-20/twig) susceptible Cultivar	Greening %	Moderately susceptible (Nymph 20-30/ twig) Cultivar	Greening %	Highly susceptible (Nymph more than 30) Cultivar	Greening %
1	2	3	4	5	6	7	8	9	10	11
Sweet orange	-	-	-	-	Golden Nugget	22	Musanbi	100	Madan Vinus	100
	-	-	-	-	Joppa	20	Valencia	72	Campbell Valencia	75
	-	-	-	-	Tardiff	100	Jaffa	100	Orange of haven	100
	-	-	-	-	Navalencia	100	Hamlin	80	Olinda Valencia	100
	-	-	-	-	Vaniella	100	Blood Red	100	Italian	100
	-	-	-	-	-	-	-	-	Pineapple	100
Mandarins	-	-	Laddu	-	Foutrels early	100	Coorg	100	Kara	100
	-	-	Bilikitchili	-	Satsuma	60	Cleoptera	100	Honney	100
	-	-	-	-	Thronton	22	-	-	Kinnow	50
	-	-	-	-	Nagpur	20	-	-	Dancy	75
	-	-	-	-	Lahore Local	60	-	-	King	100
	-	-	-	-	Navel tight	10	-	-	Clementine	100
	-	-	-	-	-	-	-	-	Sweto	100
	-	-	-	-	-	-	-	-	Milking	100
Limes & Lemons			West Indian lime		Florida Rough lemon	-	Jatti Khatti	100	Jullundri Khatti	100
	-	-	Badri Lemon	-	Kagzi Kalan	-	-	-	Kagzi lime	100
	-	-	Sweet Chikna	-	Baramasi	-	-	-	Lime orange	100
	-	-	Hill Lemon	-	-	-	-	-	Iran Lemon	100

1	2	3	4	5	6	7	8	9	10	11
Citranges	-	-	-	-	Troyer	50	Savage	50	Carrizo	50
Trifoliate & its hybrids	-	-	-	-	Rubidoux	0	-	-	Citrumelo	100
	-	-	-	-	-	-	-	-	Saccaton Citrumelo	100
Tangelos	-	-	-	-	-	-	-	-	Orlando	100
	-	-	-	-	-	-	-	-	Minnola	100
	-	-	-	-	-	-	-	-	Pearl	75
	-	-	-	-	-	-	-	-	Sampson (Seedless)	100
Miscellaneous	-	-	Gajanooma	-	Severonia Buxifolia	50	Pectinifera	100	Clanodin	50
	Pomari	-	-	-			Citron	100	Clausena macrophylla	100
	Anil bed	-	-	-	-	-	Satkara	100	Citrus twanica	100
	-	-	Kharna Khatta	-	-	-	-	-	Nasnarn	100
	-	-	-	-	-	-	-	-	Mutation	100
	-	-	-	-	-	-	-	-	Citrus macroptera	100
	-	-	-	-	-	-	-	-	Sadaphal	100

liko Laddu and Bili Kitchli mandarins, West Indian lime, Badhri lemon, Sweet Chickna Sweet lime, Hill lemon and Gajanima.

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H-1.10 (L) vii : Studies on seasonal occurrence and population density of citrus psylla (Diaphorina citri) and its control

S.S. Cheema, S.K. Kapur and Balraj Singh

Density population of citrus psylla was recorded from April, 1975 to March, 1976 on Blood Red sweet orange at 3 different locations in the Punjab namely Ludhiana, Abohar/Jagraon and Hoshiarpur. During these months the lowest population level was recorded at Hoshiarpur and the highest at Jagraon followed by Ludhiana (Table 42). The lower population at Hoshiarpur may be attributed to mild climate.

TABLE 42 : Density population of citrus psylla per 8 twigs (10 cm each) at three different places from April 15 to March, 1976

Month	Ludhiana		Abohar/Jagraon		Hoshiarpur	
	Adults	Nymphs	Adults	Nymphs	Adults	Nymphs
April	-	1.0	-	-	5.0	-
May	57	-	6	3	3.5	0.5
June	74.4	3.1	18	8	-	-
July	7.2	27.5	6	-	-	-
August	1.5	12.9	-	-	-	-
September	0	4.5	-	-	-	-
			Jagraon			
October	0.5	1.0	0.8	8.0	0.3	0.8
November	2.5	13.3	3.0	19.30	0.1	0.5
December	0.8	6.2	4.2	2.6	0.2	0.6
January, 1976	1.0	0.9	9.6	0.0	0.4	-
February	1.5	1.1	6.7	5.2	0.3	-
March	0.8	36.6	0.8	67.3	0.2	1.6

H-1.12 (A) : Studies on granulation in citrus

M.S. Bajwa, S.K. Munshi, V.K. Vij
and S.K. Thakai

Granulation in citrus is a serious problem in the arid-irriga tract of the Punjab. To ascertain the extent of granulation in the Sta a comprehensive survey of the citrus orchards was initiated in 1975-76. This report pertains to the studies carried out at the Regional Fruit Research Station, Abohar.

The trees of selected cultivars were categorised into (a) healthy (b) 25% declined (c) 50%declined and (d) 75% declined, on the basis of visual observations like tree vigour, foliage density, chloros and bark splitting. There were five replications in each category and 10 fruits per tree were collected one month before the optimum harvest period of cultivar, at the proper maturity time and one month after ripening period. The details of the cultivars and the picking times ar given below :-

1-	Musambi	: October, November, December
2-	Hamlin Jaffa Pineapple Desi Sangtra Dancy Grapefruit	: November, December, January
3-	Blood Red	: December, January, February
4-	Valencia Kinnow	: January, February, March

Apart from above, granulation in different cultivars of swee orange budded on different rootstocks was also studied.

Extent of granulation in each fruit was recorded as under :-

A = Normal fruit

B = 0-25% granulated fruit

C = 25-50% granulated fruit

D = 50-75% granulated fruit

E = 75-100% granulated fruit

The intensity of granulation was calculated by the following formula :-

$$\text{Normalcy index of the tree} : \frac{Ax5+Bx4+Cx3+Dx2+Ex1}{\text{Total number of fruits}}$$

This index is the grade point average of a tree on 5.00 basis. The higher values designated less granulation and lower values represent more granulation.

The perusal of data in Table 44 has revealed that granulation increased with the approaching of harvest time in citrus fruits. The differences in granulation between one month before harvest and at proper harvest of the fruit is more marked in sweet orange - cv. Jaffa. Furthermore, the granulation was more pronounced in Jaffa than all other citrus cultivars. Kinnow mandarin at the ripening period was having maximum number of normal fruits. Further, the intensity of decline in citrus, contributed much towards the incidence of granulation; it was more pronounced in Jaffa, Pineapple, Hamlin, Desi Sangtra. However, in other cultivars, the decline did not affect the incidence of granulation in the fruits.

Regarding sweet orange cultivars grown on different root-stocks, Blood Red produced maximum no. of normal fruits while the same rootstocks under Jaffa (Cleopatra - not tried) produced maximum

granulation (Table 43).

TABLE 43 : Granulation index of five sweet orange cultivars on different rootstocks

Rootstocks	Sweet orange cultivars				
	Blood Red	Musambi	Jaffa	Valencia	Pineapple
Jatti Khatti	3.6	3.1	3.0	4.2	3.6
Kharna Khatta	3.8	3.3	2.41	4.0	3.3
Troyer	3.8	D	3.5	4.4	4.2
Carrizo	4.3	D	2.6	4.1	3.8
Rangpur Lime	4.1	3.2	D	4.3	N T
Pectinifera	4.8	4.6	2.4	N T	N T
Pineapple	N T	N T	4.1	N T	N T
Cleopatra	4.8	N T	N T	4.3	N T
Citrumelo	4.8	D	2.3	4.4	N T
Jambhiri	N T	2.9	N T	N T	N T

D = Dead
N T = Not tried

In case of Blood Red on different rootstocks, Cleopatra, Pectinifera and Citrumelo were the best having maximum normal fruits, whil Jatti Khatti produced highest granulated fruits. In Musambi, Pectinifera produced highest normal fruits and Jambhiri highest granulated fruits. In case of Jaffa cultivar, Jaffa/Pineapple proved to be the best combinati from granulation point of view. In Valencia; different rootstocks did not affect much the granulation in the fruits. Pineapple, however, had more granulated fruits with Kharna Khatta and less in Troyer. It is, therefore, evident that rootstocks has a propound effect on granulation.

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TABLE 44 : Granulation Index in citrus cultivars at three dates of harvest of the fruits

Citrus cultivars	Healthy Fruits			25% declined			50% declined			75% declined		
	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3
Sweet Orange												
Blood Red	4.1	3.9	-	4.2	4.2	-	4.2	3.5	-	4.2	3.6	-
Musambi	-	3.4	-	-	3.8	-	-	2.7	-	-	3.3	-
Jaffa	3.4	2.1	-	2.8	1.7	-	3.2	1.6	-	2.2	1.6	-
Pineapple	4.5	3.8	-	3.8	2.6	-	4.5	3.7	-	3.5	3.1	-
Hamlin	3.8	3.1	-	3.4	2.3	-	3.3	2.9	-	-	-	-
Valencia	4.2	4.1	4.1	-	-	-	4.7	4.3	-	-	-	-
Mandarin												
Kinnow	4.4	4.8	-	4.7	4.5	-	4.3	4.8	-	4.7	4.5	-
Desi Sangtra	5.0	4.6	-	-	-	-	4.8	4.3	-	3.7	2.2	-
Tangerine												
Dancy	-	1.5	-	-	-	-	-	1.8	-	-	-	-
Grapefruit												
Marsh Seedless	4.3	4.2	-	4.2	3.9	-	4.6	3.8	-	4.8	4.3	-
Foster	-	-	-	-	-	-	4.9	4.6	-	5.0	4.6	-

T_1 - One month before normal time, T_2 - At normal time, T_3 - One month after normal time

2 GRAPES

H-2.1 (A) i : Varietal trial on grapes to find varieties for arid-irrigated regions of Punjab .....

M.S. Bajwa, J.N. Sharma and P.S. Sarowa

With a view to select best grape cultivars for the arid-irrigated regions of Punjab, a grape varietal trial was laid out with the following experimental details in March, 1966.

Cultivars	:	Ten - Viz. Khalili, Bedana, Beauty Seedless, Anab-e-Shahi, Delight, Perlette, Early Muscat, Gold and Selection-7.
Replications	:	Four
Tree unit per plot	:	Four vines
Experimental design	:	R B D

Data collected on sprouting dates, average girth and number of clusters per vine in different cultivars (Table 45) showed that out of the ten cultivars, Beauty Seedless was the earliest (March, 3) to sprout. All the cultivars had initiated sprouting by 15th of March, Selection-7 being the last to sprout. Sprouting was completed in case of Beauty Seedless by 20th March, whereas, Selection-7 continued to sprout upto 5th April.

Anab-e-Shahi maintained a significant lead (34.9 cm) in trunk girth over other cultivars this year as well. Next in the descending order were Beauty Seedless, Selection-7, Khalili, Bedana, Perlette, Pus Seedless, Delight, Gold and Early Muscat in this attribute. Beauty Seedless bore significantly higher number of clusters (55.6) per vine than all others. Minimum number of clusters (7.8) was recorded in Beda

Maximum yield was in Beauty Seedless (18.515 kg) followed by Perlotte, Delight, Selection-7, Early Muscat, Gold, Anab-e-Shahi, Pusa Seedless and Bedana in the descending order with 18.428, 7.022, 3.574, 2.510, 2.002, 1.797, 1.754 and 1.615 kg respectively.

TABLE 45 : Sprouting dates, trunk girth and number of clusters per vine under the grape varietal trial (1976 data)

Cultivars	Date of sprouting		Av. trunk girth (cm)	Av. No. of clusters/ vine	Av. Yield per vine (kg)
	Start	End			
Khalili	8/3	26/3	30.9	11.2	-
Bedana	12/3	30/3	30.3	7.8	1.615
Beauty Seedless	3/3	20/3	32.7	55.6	18.515
Pusa Seedless	11/3	28/3	28.3	11.1	1.754
Anab-e-Shahi	11/3	1/3	34.9	8.6	1.797
Delight	5/3	28/3	28.2	26.2	7.022
Perlotte	4/3	27/3	29.0	35.1	18.428
Early Muscat	5/3	24/3	23.2	16.3	2.510
Gold	11/3	30/3	24.3	13.9	2.002
Selection-7	15/3	5/4	32.2	9.9	3.574
C.D. at 5%	-	-	5.5	9.9	

Salient features pertaining to physico-chemical characters of different cultivars are given in Table 46.

Beauty Seedless, Early Muscat and Perlotte were the earliest to ripen in the second week of June, whereas, Bedana, Pusa Seedless ripened in the last week of June and Selection-7 and Anab-e-Shahi started ripening in the Ist week of July. Maximum cluster length (21.1 cm) was of Beauty Seedless, whereas, the smallest cluster belonged to Gold and

TABLE -46 : Physico-chemical characters of different grape cultivars under the varietal trial

Cultivars	Date of test+	Cluster size (cm) Length	Breadth	Average cluster weight (gm)	Shape index	Av.berry weight (gm)	T S S (%)	Acidity (%)	T S S Acid ratio
Khalili	*	-	-	-	-	-	-	-	-
Bedana	28.6.76	17.2	4.6	207	1.19	1.50	17.6	0.98	18.15
Beauty Seedless	12.6.76	21.1	5.6	333	1.12	1.74	14.0	0.91	15.38
Pusa Seedless	29.6.76	16.7	4.7	158	1.26	1.67	16.6	0.83	20.14
Anab-e-Shahi	1.7.76	17.9	4.4	209	1.13	3.47	13.6	0.71	18.89
Delight	19.6.76	16.4	5.2	268	1.12	1.79	13.6	0.72	19.01
Perlette	16.6.76	20.8	5.7	525	1.06	2.59	12.2	0.73	16.78
Early Muscat	11.6.76	15.7	3.2	154	1.06	3.06	15.6	0.97	16.17
Gold	23.6.76	15.7	5.2	144	1.19	4.20	14.0	0.46	30.39
Selection-7	30.6.76	18.4	5.1	361	1.23	3.69	13.2	1.08	12.17

+ Samples of eight clusters from each replication.

* As the representative samples were not available from all the vines, therefore, chemical analysis could not be conducted.

Early Muscat with 15.7 cm size. Maximum cluster broadth of 5.7 cm was recorded in Perlette and the minimum (3.2 cm) in Early Muscat. Cluster weight was maximum (525 g) in Perlette and minimum in Gold (144 g). The berry weight of Gold was the highest whereas that of Bedana was the lowest. Heavy rains interfered with the proper ripening of grapes; hence, TSS content remained low and acidity high in all the cultivars. TSS/Acid ratio was maximum (30.4) in Gold and minimum (12.17) in Selection-7.

From these results, it may be concluded that Perlette, Beauty Seedless and Delight are the earliest to ripen with good yields. Cultivars Bedana, Pusa Seedless, Anab-e-Shahi and Selection-7 are late ripeners and in general are spoiled by rains and their fruit quality is also not good.

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H-2.3 (L) ii : <u>A survey to judge the mineral nutrition status of vineyards in the Punjab</u>

G.S. Nijjar, Satish Kumar and Ajit Singh

The survey to judge the mineral nutrition status of vineyards in the Punjab was initiated in 1971. A number of vineyards, situated in various districts of the State were surveyed. Leaf samples were collected from three cultivars, i.e. Perlette, Thompson Seedless and Anab-e-Shahi. These samples were analysed for their N, P and K content and the petiole analysis results for different cultivars are presented in Tables 47, 48 and 49 alongwith the standard values. The yield of the vineyards was also estimated with the time of collecting the samples and has been categorised as high, average and low.

Nitrogen content : The N content of the petioles varied from 0.96 to 1.58, 1.23 to 1.48 and 1.10 to 1.50 per cent of dry weight in Perlette, Thompson Seedless and Anab-e-Shahi vines respectively. The nitrogen content generally was low in vineyards of high productivity in Perlette and Anab-e-Shahi cultivars whereas the same was higher in vineyards of low yields. In the case of some vineyards, the values observed were even higher than the upper standard of 1.30. In case the Thompson Seedless cultivar, as the number of vineyards with high and low productivity was small, no definite trend could be established between petiole N and level of productivity. The data, thus showed that lower levels of nitrogen are associated with high productivity.

Phosphorus content : The phosphorus content of petioles varied from 0.22 - 0.72, 0.32 - 0.58 and 0.40 to 0.77 per cent of dry weight in Perlette, Thompson Seedless and Anab-e-Shahi vines respectively The phosphorus content also showed a decrease with the increase in the productivity level of all the cultivars. Almost all the samples in the three cultivars showed values higher than the recommended range. The individual samples from high yielding Perlette and Anab-e-Shahi vineyards ranged from 0.25 - 0.57 and 0.40 - 0.65 per cent, respectively. The high phosphorus status of the vineyards would suggest that phosphorus uptake was not influenced by the nitrogen fertilization.

Potassium content : The potassium content of the petioles varied from 2.10 to 5.30, 3.20 to 5.30 and 4.00 to 5.70 per cent of dry weight in Perlette, Thompson and Anab-e-Shahi vines, respectively. The potassium content also showed decrease with the increased productivity. The values of potassium were higher in all the samples than the recommend value of 1.50 per cent. The potassium content was lower in petioles of

TABLE 47 : N, P and K status of Perlette cultivar in vineyards located at different places in the Punjab

Sr.No.	Locality	N	P	K	Estimated yield
		Per cent dry matter			
1-	Hoshiarpur	1.16	0.40	4.50	High
2-	"	1.02	0.25	4.10	High
3-	"	0.98	0.27	4.30	High
4-	"	1.20	0.35	4.60	High
5-	Ludhiana	1.28	0.65	4.10	Average
6-	"	1.30	0.50	4.30	Average
7-	"	1.12	0.50	4.50	High
8-	"	1.16	0.30	4.50	High
9-	"	1.58	0.67	4.30	Low
10-	"	1.12	0.25	3.80	High
11-	"	1.25	0.35	4.60	Average
12-	"	1.52	0.72	4.10	Low
13-	"	1.10	0.42	3.00	High
14-	"	1.43	0.62	5.30	Low
15-	Jullundur	1.18	0.52	4.30	High
16-	"	1.15	0.42	4.10	High
17-	"	1.28	0.70	4.70	Average
18-	Amritsar	0.96	0.57	4.20	High
19-	Ropar	1.10	0.42	3.60	High
20-	"	1.32	0.40	2.10	Average
21-	Ferozepur	1.28	0.52	4.20	Average
22-	"	1.05	0.35	4.10	High
23-	"	1.10	0.30	4.60	High
24-	"	0.98	0.25	4.20	High
25-	"	1.18	0.50	4.90	High
Range		0.96-1.58	0.22-0.72	2.10-5.30	
Cahoon (1970)		0.90-1.30	0.16-0.30	1.50-2.50	

TABLE...18 : N, P and K status of Thompson Seedless cultivar in vineyards located at different places in the Punjab

Site No.	Locality	N	P	K	Estimated yield
		Per cent dry matter			
1-	Hoshiarpur	1.40	0.40	5.20	Average
2-	"	1.32	0.55	5.30	Average
3-	Ludhiana	1.48	0.55	3.60	Low
4-	"	1.28	0.40	3.80	Average
5-	"	1.32	0.45	3.20	Average
6-	Jullundur	1.23	0.50	3.30	High
7-	Ferozepur	1.33	0.58	4.20	Average
8-	"	1.28	0.55	3.50	High
9-	"	1.38	0.42	3.30	Average
	Range	1.23-1.48	0.32-0.58	3.20-5.30	
	Cahoon (1970)	0.90-1.30	0.16-0.30	1.50-2.50	

TABLE....49 : N, P and K status of Anab-e-Shahi cultivar in vineyards located at different places in Punjab

Site No.	Locality	N	P	K	Estimated Yield
		Per cent dry matter			
1-	Hoshiarpur	1.34	0.62	5.30	Average
2-	"	1.40	0.60	4.90	Average
3-	"	1.30	0.57	4.60	Average
4-	Ludhiana	1.42	0.77	5.10	Low
5-	"	1.50	0.70	4.90	Low
6-	"	1.40	0.62	5.20	Average
7-	"	1.28	0.50	5.40	High
8-	"	1.32	0.60	5.70	Average
9-	"	1.25	0.65	4.60	High
10-	"	1.44	0.75	4.90	Low
11-	"	1.48	0.62	5.20	Low
12-	Amritsar	1.28	0.52	4.30	Average
13-	Jullundur	1.18	0.45	4.70	High
14-	"	1.08	0.40	4.80	High
15-	"	1.22	0.55	4.30	Average
16-	Ferozepur	1.12	0.57	4.50	High
17-	"	1.08	0.60	4.00	High
18-	"	1.18	0.65	4.30	High
19-	"	1.10	0.55	4.10	High
20-	Ropar	1.18	0.65	4.50	High
21-	"	1.22	0.65	4.60	Average
	Range	1.10-1.50	0.40-0.77	4.00-5.70	
	Cohoon	0.90-1.30	0.16-0.30	1.50-2.50	

Perlette and Thompson Seedless than that of Anab-e-Shahi vineyards of comparable vigour.

On the whole, the survey indicated that our vineyards are being supplied with higher doses of fertilizers (particularly P and K The excess application of these nutrients is causing imbalances in th vineyard nutrition due to which deficiency symptoms of Zn, Mn and B h been observed in quite a number of orchards during survey.

**

H-2.4 (A) i : Thinning of Perlette grapes by hand and chemicals

M.S. Bajwa, V.K. Vij and S.K. Thatai

This project was started in April,1973, in order to compar the efficacy of different treatments for obtaining loose clusters wit lesser number of shot berries. The experimental details are given be

Treatments : Six, viz.

1- Control
2- Berry thinning (removal of lower hal portion of the cluster at fruit-set)
3- GA dipping (30 ppm at 50% bloom)
4- CCC dipping (1000 ppm at full bloom)
5- Sevin dipping of clusters (1000 ppm full bloom)
6- Sevin spray on vines (1000 ppm at fu bloom)

Replications : Four

Experimental design : R B D

The treatments were applied at the appropriate stages. Th fruit analysis work could not be carried out due to spoilage of the f on account of continuous heavy rains during the ripening time of Perl

H-2.6 (L) i : Chemical Weed Control in Grapes

B.S. Dhillon, Y.R. Chenena and G.S. Bajwa

Six herbicides viz. Diuron, Gesatop (simazine), Gesaprim (Atrazine), Tafazine, Basalin and TOK E-25 were tried for the control of weeds in the Punjab Agricultural University vineyard, in two doses of each chemical. There were thus thirteen treatments including an unweeded control. The trial was conducted in randomised block design with three replications in a 2 m x 2 m plot size. Observations on weeds control were recorded after 30 and 60 days of spraying. A systematic survey of weed population before the treatments showed that the area was infested mostly with cynodon, dactylon, cyperus rotundus, Flusine egiypticum conchrus catharticus, Rumex acutus, Euphorbia hitra Tribulus terristris, Boerhaavia diffusa Amaranthus viridis, Dicoric arvensis. The rampant weeds of experimental plots were monocot weeds. The data recorded on the average number of weeds as affected by various treatments were presented in Table 50.

It is evident that all the weedicidal treatments reduced the weed population and were found to be significantly superior to the unweeded control. Furthermore all the weedicides brought greater reduction of broad leaf weeds than the grasses (monocots). The data also indicate that among the weedicides trees, Diuron in both the doses proved most effective for the control of weeds. However, in general there was no significant difference in relative response of varying levels of weedicides applied. This indicates that lower concentrations of the weedicides applied were equally effective in controlling both the dicot and monocot type of weeds. None of the weedicides tried, showed any phototoxic effect on the vines.

TABLE....50 : Effect of different weedicides on the intensity of weeds

	Treatments	Mean number of weeds after 30 days		Mean number of weeds after 30 days		Total
		Monocots	Dicots	Monocots	Dicots	
T_1	Diuron 3 kg/ha	4.3	-	6.6	-	6.6
T_2	Diuron 3.5 kg/ha	4.0	-	5.3	-	5.3
T_3	Gesatop (Simazino) 3 kg/ha	14.3	-	21.6	-	21.6
T_4	Gesatop (Simazino) 4 kg/ha	8.3	-	12.6	-	12.3
T_5	Gesaprim (Atrazino) 3 kg/ha	5.0	-	9.0	0.7	9.7
T_6	Gesaprim (Atrazino) 4 kg/ha	5.0	-	7.0	-	7.0
T_7	Tafazino 4 kg/ha	4.6	-	8.0	-	8.0
T_8	Tafazino 5 kg/ha	4.6	-	6.6	-	6.6
T_9	Basalin 3 kg/ha	25.0	-	30.0	2.0	32.0
T_{10}	Basalin 4 kg/ha	30.6	-	37.3	0.7	38.0
T_{11}	Tok E-25 5 litres/ha	1.6	-	8.0	-	8.0
T_{12}	Tok E-25 6 litres/ha	6.0	-	10.4	-	10.4
T_{13}	Control (unweeded)	34.3	30.3	64.6	48.3	112.9
	C.D. at 5 per cent		11.43			14.19

H-2.7 (L) i : Hybridization studies to evolve early ripening and seedless varieties of grapes

J.S. Jawanda and Jog Raj Chanana

A grape breeding programme has been underway in the Department of Horticulture since 1969, with a view to evolve early ripening, high quality, seedless grape cultivars suitable for cultivation in the sub-tropical climate of northern India. A large number of hybrid progenies have been raised from a number of inter-cultivar crosses.

Plantation of hybrid seedlings :

A total of 2,473 hybrid seedlings were set to the field during February, 1974. The plantation has been done at 5' x 5' distance and the hybrid seedlings have been trained on Head System. The details of number of plants of different parental combinations along with the mortalities and survival to date are given in Table 51.

TABLE 51 : Grape hybrid seedlings planted in the field during February, 1974

Sr.No.	Cross			No. of plants	Mortality	No. of plants survived
1-	Banquabad	x	Himrod	150	3	147
2-	Banquabad	x	Perlette	480	31	449
3-	Banquabad	x	Thompson Seedless	960	203	757
4-	Karachi Gulabi	x	Thompson Seedless	240	72	168
5-	Karachi Gulabi	x	Himrod	560	177	383
6-	Karachi Gulabi	x	Perlette	40	19	21
7-	Early Muscat	x	Perlette	3	-	3
8-	Early Muscat	x	Beauty Seedless	40	10	30
	TOTAL			2473	515	1958

It is evident that out of total of 2,473 hybrid plants some 515 seedlings either failed to establish or did subsequently and thus the survival was 79.2 per cent. The remaining hybrid seedlings were making vigorous growth. All the hybrid seedlings were given appropriate plant protection measures, to keep them free of insects and diseases.

Precocity in bearing :

Out of a total of 1958 surviving F_1 hybrids, some 170 fruited in 1976 as per details given in Table 52.

TABLE 52 : Number of plants of different inter-cultivar crosses when came into bearing during fruiting season of 1976

Sr.No.	Cross			No. of plants	Total No. of plants analysed	Percentage
1-	Banquabad	x	Himrod	147	51	34.00
2-	Banquabad	x	Perlette	449	62	13.71
3-	Banquabad	x	Thompson Seedless	757	28	3.69
4-	Karachi Gulabi	x	Thompson Seedless	168	10	5.95
5-	Karachi Gulabi	x	Himrod	383	18	3.69
6-	Karachi Gulabi	x	Perlette	21	-	-
7-	Early Muscat	x	Perlette	3	—	-
8-	Early Muscat	x	Beauty Seedless	30	1	3.33
	TOTAL			1958	170	

It is evident that a maximum of 34 per cent of hybrid seedlings from the cross of Banquabad x Himrod came into bearing during the second year of field life. This was followed by Banquabad x Perlette, and Karachigulabi x Perlette crosses in which 13.71 and 9.52 per cent plants came into bearing. In the case of Early Muscat x Perlette cross, none of the hybrids came into bearing while in the cross Early Muscat x Beauty

Seedless only one seedling fruited. This indicates that precocity in bearing may be dependant upon the male parent. Maximum (34%) proportion of plants bore fruit in the crosses of Banquebad x Himrod and Banquebad x Perlette, thus, establishing its superiority over the other parents.

Physico-chemical characteristics

Data were recorded on the number of bunches borne by each hybrid seedling, average bunch weight and total yield/vine (Table 53).

TABLE 53 : Evaluation of F_1 hybrids in respect of No. of bunches/ vine, bunch weight and total yield per vine

Sr.No.	Cross			No.of bunches per vine	Av.bunch Wt.(g)	Total yield per vine (kgs)
1-	Banquebad	x	Himrod	7.20	222.50	1.60
2-	Banquebad	x	Perlette	5.10	247.22	1.26
3-	Banquebad	x	Thompson Seedless	3.15	272.93	0.86
4-	Karachi Gulabi	x	Thompson Seedless	3.50	136.12	0.48
5-	Karachi Gulabi	x	Himrod	5.91	121.11	0.71
6-	Karachi Gulabi	x	Perlette	-	-	-
7-	Early Muscat	x	Perlette	-	-	-
8-	Early Muscat	x	Beauty Seedless	3	100.00	0.30

Observations were also recorded on physico-chemical characters of the bunches and berry to assess the quality and these data have been presented in Table 54. Maximum number of (7.20) bunches per vine were produced by the hybrids of Banquebad x Himrod combination closely followed by the crosses of Karachi Gulabi x Himrod and Banquebad x Perlette. The maximum bunch weight was recorded in the cross of Banquebad x Thompson

Seedless and the minimum in the cross of Early Muscat x Beauty Seedless. Total yield per vine was found to be the highest in the case of Banquebad x Himrod cross, followed by Banqhebad x Perlette.

More than a dozen of hybrid seedlings appeared promising in the evaluation of their bunch and berry characters (Table 54).

TABLE 54.. Bunch and berry characters of some of the promising F_1 grape hybrids

Hybrid No.	No. of bunches (pe vine)	Berry colour	Av.wt. of a berry (g)	No. of seeds per berry	T S S (%)
BH 19	7	Greenish yellow	1.75	2-3	20
BH 26	6	Greenish yellow	3.50	2-4	21
BH 26	6	Golden	2.37	2-3	21
BH 29	17	Golden	1.37	3	20
BH 38	2	Greenish Yellow	3.25	2-4	23
BH 3	2	Greenish Yellow	1.37	2	23
BH 31	2	Greenish Yellow	1.60	2-3	20
BH 8	5	Golden	2.25	2-3	23
BP 25	1	Golden	2.0	1-2	20
BP 30	1	Yellow	2.25	1-2	23
BP 18	3	Golden	2.0	2-4	20
BP 7	1	Golden	2.50	2-3	26
BP 17	3	Golden	2.25	2-3	20
BT 4	2	Greenish Yellow	2.25	1-2	23

These are mostly from the crosses of Banquebad x Himrod, Banquebad x Perlette and Banquebad x Thompson Seedless, Hybrid No. BP 18 (Banquebad x Perlette) was the earliest to ripen i.e. 30th May when it had attained

a T S S of 20 per cent. Another hybrid from this cross had a T S S of 26% which is quite high. In general, the promising hybrids listed in Table 55 had a T S S ranging between 20-26 per cent. None of these hybrids, gave seedless berries although the pollen parent was a seedless cultivar in all the cases. This shows that seedlessness was a recessive character. It is intended to backcross some of these hybrids with the seedless parents, to incorporate seedlessness.

TABLE 55 : Classification of grape hybrids in respect of total soluble solids

Cross			No.of hybrids analysed	Low (Below 15%)		Medium (15-20%)		High (Above 20%)	
				No.	%	No	%	No	%
Banquabad	x	Himrod	51	0	0.00	42	82.35	9	17.65
Banquabad	x	Perlette	62	12	19.35	42	67.74	8	12.90
Banquabad	x	Thompson Seedless	28	6	21.43	19	67.84	3	10.71
Karachi Gulabix		Thompson Seedless	10	0	0.00	9	90.00	1	10.00
Karachi Gulabix		Himrod	18	2	11.11	14	77.77	2	11.11
Karach Gulabi	x	Perlette	-	-	-	-	-	-	-
Early Muscat	x	Perlette	-	-	-	-	-	-	-
Early Muscat	x	Beauty Seedless	1	0	0.00	1	100.00	-	-

Berry Quality

The data regarding the berry quality of different crosses are presented in Table 54. On the basis of T S S content of berries, the following classification has been made :

Low = T S S less than 15 per cent

Medium = T S S ranging between 15-20 per cent

High = T S S more than 20 per cent

In general, in all the crosses, majority of the grape hybrid produced berries with medium T S S. The proportion of such hybrids ranged between 67.74 to 100 per cent. The proportion of hybrids with high T S S ranged from 10.00 to 17.65 per cent in the case of Karachi Gulabi x Thompson Seedless and Banquband x Himrod crosses. As compared this, the percentage of hybrids with low T S S ranged from 0 to 19.35 per cent.

Seedlessness

Out of 170 hybrid seedlings screened this year, 9 have been found to be soft-seeded and 6 practically seedless (Table 54). The remaining grape hybrids which did not come into bearing this year, will be evaluated in the subsequent years.

**

H-2.8 (L) i : Studies on Cold Storage of Grapes

S.S. Mann, B.S. Dhillon and J.S. Randhawa

The effect of polythene wrappers of various thickness on storage behaviour of Anab-e-Shahi grapes was studied during the year 1975. The experiment had the following treatments :-

T_0 = Control (stored as such in boxes)

T_1 = Stored in 100 gauge polythene wrappers

T_2 = Stored in 200 gauge polythene wrappers

T_3 = Stored in 300 gauge polythene wrappers

The grape bunches placed in polythene wrappers were kept i

wooden boxes and hold in cold storage at a temperature range of 0-3.3°C and relative humidity of 85 to 90 per cent.

The fruit was taken out of the storage after 20, 40, 50 and 60 days and physico-chemical analysis and observation on loss in weight, berry shatter and spoilage were carried out on each date.

Among all the treatments the loss of weight was the minimum in the fruit placed in 300 gauge polythene wrappers (Table 56) and it followed an increasing trend in 200, 100 gauge polythene wrappers and control. There was not much difference in berry shatter under various treatments. The spoilage was least in control where as it increased with the increased thickness of polythene wrappers. The composition of grapes in respect of T S S, acidity and reducing sugars did not differ markedly due to different treatments.

TABLE..56 : Effect of polythene wrappers on loss in weight, spoilage berry shatter and chemical composition during storage of Anab-e-Shahi

Treatment	Wt. Loss (%)	Berry shatter (%)	Spoilage (%)	T S S	Acidity (%)	Reducing sugars (%)
T_0	7.24	2.33	13.92	13.5	.41	12.29
T_1	4.94	2.71	20.02	13.1	.45	10.78
T_2	5.60	2.34	24.19	13.6	.49	11.07
T_3	1.46	2.84	28.22	13.0	.43	10.76

The data represents the mean of all sampling dates (viz. 20, 40, 50 and 60 days)

**

H-2.9 (L) i. Training-cum-pruning trial on grapes

A.S. Bindra, J.S. Bhullar and S.S. Brar

This trial was started during the year 1968 on ten promising grape cultivars trained on four training systems with the following experimental details :-

Cultivars : Ten, viz.

1- Beauty Seedless
2- Bedana
3- Himrod
4- Perlette
5- Thompson Seedless
6- Anab-e-Shahi
7- Early Muscat
8- Khalili
9- Karachi Gulabi
10- Gold

Training Systems

1- Head
2- Bower
3- Kniffin
   a) Unilateral
   b) Bilateral
4- Telephone
   a) Unilateral
   b) Bilateral

Pruning severity : The vines were subjected to 3 bud, 6 bud and 9 bud pruning.

Distance of planting : 3 m x 3 m

Design of layout

Four different blocks of four training systems, viz. Head, Kniffin, Bower and Telephone were made. In each block, one row was

assigned to single variety which contained 18 vines. In Kniffin and Telephone system first half number of vines were trained to unilateral and second half to bilateral cordons.

Out of these ten varieties only four to five varieties bear fruit sufficient for physico-chemical analysis. Beauty-seedless gave the highest yield of 16.54 kg per vine on Bower-system (Table 57) with 3 bud pruning severity. Himrod gave the highest yield of 9.8 kg per vine on Bilateral Kniffin system with 3 bud pruning severity. Similarly Perlette gave highest yield on Kniffin system. Karachi Gulabi gave the highest yield on Telephone and Bower system of training with 3 bud pruning severity. There was no difference in the bearing of Anab-e-Shahi and Gold on different systems. No difference was also noted in T S S and acidity on different systems among different varieties.

**

H-2.9 (L) ii : Spacing trial on grapes Cv. Perlette

A. S. Bindra and S.S. Brar

This trial was started during the year 1973 to find out the suitable distance for Perlette grape trained on Head System. The details of the experiment are given below :-

Spacing distance	:	3.0 m x 3.0 m
		3.0 m x 2.5 m
		3.0 m x 2.0 m
		2.5 m x 2.0 m
		2.0 m x 2.0 m
		2.0 m x 1.5 m
Replications	:	Four
Experimental plants	:	480
Non-experimental plants		240

TABLE 57 : Yield and quality data of different cultivars trained on different systems

KNIFFIN SYSTEM

	3 bud			6 bud			9 bud			3 bud			6 bud			9 bud		
	Yield kg	TSS %	Acidity %	Yield kg	TSS %	Acidity %	Yield kg	TSS %	Acidity %	Yield kg	TSS %	Acidity %	Yield kg	TSS %	Acidity %	Yield kg	TSS %	Acidity %
Beauty Seedless	4.80	14.2	.340	5.2	15.2	.340	4.35	15.0	.330	7.00	15.5	.330	7.75	16.0	.330	4.2	16.2	.300
Himrod	4.00	18.3	.400	5.2	18.2	.400	4.50	16.6	.450	9.8	18.4	.350	6.35	18.5	.300	5.5	17.5	.380
Perlette	5.60	15.5	.540	1.90	14.7	.600	3.30	14.5	.670	-	-	-	5.50	15.5	.600	2.50	16.0	.600
K.Gulabi	-	-	-	-	-	-	3.50	17.0	.370	1.90	16.5	.500	6.50	18.0	.470	6.940	16.5	.525
Anab-e-Shahi	2.25	15.2	.500	2.125	16.0	.530	1.25	15.0	.540	1.30	15.0	.640	2.00	16.2	.530	2.125	14.0	.600
Gold	1.00	15.5	.330	1.40	16.0	.302	1.35	16.0	.300	1.8	16.0	.340	2.50	16.5	.350	2.00	16.0	.325

TELEPHONE SYSTEM

Beauty Seedless	4.40	16.0	.370	3.50	15.5	.340	3.34	15.0	.450	8.60	16.0	.340	6.60	16.5	.350	2.10	16.0	.300
Himrod	5.60	19.4	.300	4.2	20.0	.340	4.80	18.0	.400	7.7	2.10	.300	6.06	19.0	.350	3.10	19.2	.425
Anab-e-Shahi	4.50	15.0	.650	1.80	15.0	.300	1.50	14.0	.670	1.10	16.0	.450	-	-	-	9.00	14.0	.650
K.Gulabi	6.56	17.0	.540	8.74	17.5	.540	5.70	18.0	.540	8.00	17.0	.640	-	-	-	3.30	18.0	.450

Total No. of plants : 720

Design : RBD

All the vines have not come into bearing during 1976. The yield and quality data are presented in Table 58.

TABLE 58 : Yield and quality data of Perletto grapes on different spacings

Spacing m	Av.No. of bunches	Av. wt./ bunch (g)	Yield in quintal per acre	T S S	Acidity (%)
3 x 3	3.7	255.5	4.17	17.9	.65
3 x 2.5	3.0	245.2	4.94	16.2	.67
3 x 2	2.9	230.0	4.40	18.0	.58
2.5 x 2	2.8	224.3	5.02	17.5	.58
2 x 2	3.7	231.8	8.57	17.0	.67
2 x 1.5	3.3	190.2	8.15	16.0	.70

The data in (Table 58) show that the highest number of bunches per vine (3.7) was recorded in 3.0 m x 3.0 m and 2.0 m x 2.0 m spacings but the yield per acre was the highest in 2.0 m x 2.0 m spacing. Similarly the average weight of the bunch was highest in 3.0 m x 3.0 m and it was lowest in 2.0 m x 1.5 m spacing. The highest T S S (18.0%) and lowest acidity (0.58%) was recorded in 3.0 m x 2.0 m spacing.

**

H-2.10 (L) i : <u>Screening of germplasm of grapes against diseases</u> (anthracnose, cercospora leaf spot, collar rot etc.)

S.P. Kapur, Shashi Kapur and Horticulturist(Breeding)

Forty hybrids each of two crosses viz. Banquebad x Himrod and Banquebad x Perletto were screened against Anthracnose and Cercospora

leaf spot diseases.

Of the 40 hybrids of first cross (Banquebad x Himrod) 12 were infected with Cercospora, 3 with Anthracnose and 4 with both. Twenty one hybrids were free from both diseases.

Most of the hybrids obtained from the cross Banquebad x Perlette were susceptible to both the diseases. Out of 40 hybrids screened, 10 were found infected with Anthracnose, 8 with Cercospora leaf spot and 14 with both. Only 8 hybrids were free from both the diseases.

**

H-2.11 (L) i : Identification, biology and control of grape vine pests

J.S. Khangura and G. S. Sandhu

No new pest was recorded. In the Punjab Agricultural University vineyard, grapevine thrips (Rhipiphorothrips cruentatus Hood) leaf hopper (chlorita lyhica), leaf roller (sylepta lunalis), grape vine mite (oligonychus mangiferous) and scale insects were most active. Scarabid beetles, Holotrichia consanguinea, Schizonycha ciliicollis and Anomala bengalensis, caused damage in the 2nd fortnight of June. Certain birds, viz. bank mayna, bulbul, sunbird and crows also inflicted a lot of damage to grapes.

A- Efficacy of carbaryl for the control of leaf hopper

All the three dosages (0.15%, 0.1% and 0.05%) were equally effective for the control of leaf hopper upto 30 days.

B- Efficacy of different insecticides for the control of leaf hopper and thrips

Seven insecticides, viz. carbaryl, dimethoate, endosulfan,

fenitrothion, teptophos, fenthion and monocrotophos with two dosages 0.05% amel 0.025% were tested on the Himrod cultivar for the control of leaf hopper and thrips. All the insecticidal treatments were equally effective in controlling leaf hopper upto 9 days, but for the control of thrips all were equally effective up to 30 days.

**

New Project : Flower and bud drop in Thompson Seedless grapes. Some histological aspects

A. S. Bindra

In continuation of studies to find out causes and control of the disorder resulting in drop of flowerbuds, flowers and unfertilized berries (couluro) some histological studies were conducted. Attempt was made to find if the breakage of the pedicel of the flower buds is mechanical as suggested by some reports or it is due to formation of an abscission layer in the zone. The conditions of pollens and the ovule was also studied. Buds of Thompson Seedless at various stages of development were collected. They were killed in F.A.A. embedded in wax and their sections were cut. After staining with Malchite green they were examined under microscope with magnification 50 to 500.

Pollen grains were studies for their viability by aceto-carmine and sugar solution germination tests.

Drop of a flower buds or a flowers was invariably accompanied by an abscission layer formation. The cells in this zone were much less elongated and often irregular in shape. They stained lighter than the normal cells.

Mostly the aborted flower buds showed normal ovule formation. However, the pollens from such buds were not normal. With acetocarmine

test those pollens showed a fair percentage of non-shrivelled populati
But repeated tests to find out their fertility in sugar solution under
room temperature (36°C to 28°C) showed that not a single pollen germin
in this medium. Sugar concentration in the solution was varied from
15% to 25% but the result remained same. The temperature of the growth
medium was lowered by 5°C but that too did not cause pollen germinatio

Examination of pollens killed with F.A.A. embedded in wax and
stained with Malachite Green also revealed that most of the pollens were
distorted.

From the above observations it can be concluded that :

a) The flower buds drop due to formation of an abscission layer in their pedicel.

b) The mature buds may fail to set fruit because of non-fertilization of flowers due to sterile pollens.

c) The ovules in most flower buds dropped are normal.

It may also be pointed out that a casual observation indicat
that in the years with cool spring e.g. 1976. The drop is less,
probably because it results in lower mortality of pollens.

**

New Project : Flower and bud drop in grapevines

A.S. Bindra, G.S. Bajwa and J.S. Bhullar

Drop of flower buds and flowers is a serious problem in some commercial grape cultivars like Thompson Seedless. The studies to control the disorder have been in progress for the last two years but no consistent results were obtained. So this year the experiment was repeated with minor variations in the treatments given.

Material and Method

The experiment was conducted on seven year old Thompson Seedless vines trained on three wire vertical trellis (Kniffin System). The vines were given normal cultural practices as per recommendations of the Punjab Agricultural University. The treatments given were as in table 59. The experiment was replicated thrice and was laid according to randomized design.

The date of application were 27.3.1976 and 3.4.1976 for double treatments and 29.4.76 for single application. By the end of March all the panicles were fully emerged.

A single vine was used as plant unit and all the bunches were taken for the study of the drop intensity which was worked out by counting the number of buds on each bunch much before full bloom i.e. 6 to 8, April, on full bloom i.e. 19 to 22, April and on fruit set i.e. about 15 days later.

Results and Discussion

Of the various treatments applied, Indole acetic acid (10 ppm) treated vines retained the maximum number of buds and flowers (77.7 %) till after fruit set (Table 59). This was closely followed by Indole butyric acid (200 ppm). Indole acetic acid 20 ppm, Indole butyric acid 100 ppm and Cycocil 3000 ppm were also highly affective in controlling the disorder. Certain treatments delayed the flower-bud drop but did not reduced its ultimate intensity.

An important observation made during the study was the formation of insufficient number of bunches per vine which appears to us a problem more severe then the flower and bud drop itself.

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TABLE 59 : Effect of various growth regulators, glucose and urea spray on flower and bud-drop in Thompson Seedless grapevines

S.No.	Treatment	Concentration	Average No. of buds per bunch before full bloom	Average No. of buds/flowers per bunch at full bloom	Average No. of berries per bunch of fruit set	%age retention at full bloom	%age fruit set
1-	N.A.A.	5 ppm	302.9	263.3	138.1	81.2	55.7
2-	N.A.A.	10 ppm	212.3	225.1	156.6	91.7	61.1
3-	N.A.A.	20 ppm	276.5	242.2	151.7	87.6	57.3
4-	N.A.A.-D	5 ppm	276.0	173.9	81.8	69.2	33.2
5-	N.A.A.-D	10 ppm	292.8	274.4	79.4	93.9	27.9
6-	C.C.C.	1000 ppm	333.5	291.6	209.7	87.3	62.9
7-	C.C.C.	2000 ppm	296.8	284.5	189.5	95.7	64.9
8-	C.C.C.	3000 ppm	259.3	235.5	182.0	91.2	70.2
9-	C.C.C.-D	1000 ppm	264.2	234.2	135.9	88.6	61.3
10-	C.C.C.-D	2000 ppm	245.6	149.6	117.7	61.5	48.3
11-	I.A.A.	10 ppm	330.7	307.2	258.8	92.6	77.7
12-	I.A.A.	20 ppm	300.4	278.7	211.9	90.7	71.5
13-	I.A.A.	50 ppm	214.3	227.0	171.0	91.5	68.2
14-	I.A.A.-D	10 ppm	427.0	377.2	148.7	87.6	34.8
15-	I.A.A.-D	20 ppm	325.3	254.1	122.4	79.1	39.0
16-	I.B.A.	50 ppm	308.9	277.3	198.9	90.3	67.1
17-	I.B.A.	100 ppm	246.6	229.6	170.1	93.0	71.2
18-	I.B.A.	200 ppm	264.5	240.1	199.0	90.8	75.1
19-	I.B.A.-D	50 ppm	334.9	300.1	227.8	82.5	68.7
20-	I.B.A.-D	100 ppm	293.3	277.5	191.7	95.3	65.1
21-	Glucose	1 %	239.7	202.7	97.2	70.8	40.6
22-	Glucose	2 %	333.6	256.6	153.7	79.6	49.3
23-	Urea	½ %	420.1	366.4	235.8	86.2	54.8
24-	Urea	1 %	262.7	236.2	150.9	89.1	56.6
25-	Control	-	225.5	197.5	112.3	88.2	46.2
	C.D. at	5%				13.4	14.0
		1%					

3 - M A N G O

H-3.2 (G) i : Propagation studies on mango

Sohan Singh and Horticulturist

The studies to find out a dwarf rootstock for mango were initiated during 1970. The seed stones of three polyembryonic cultivars namely, Olour, Kurukkan and Mayilpilian were collected from the District Agricultural Farm, Taliparamba (Kerala) during 1973 and were sown during the same year. The stones of Mayilpilian did not germinate, whereas four and seventeen seedlings were obtained from Olour and Kurukkan cultivars, respectively. These seedlings were transplanted during September, 1975 and subsequently headed back to 7.5 cm from the ground level during January, 1976 to encourage more shoots. Each plant is at present carrying 6-8 shoots which will be layered during July, 1976 and uniform rootstock plants propagated. These seedlings would be top-worked with Dusheri scion and performance of the stones will be evaluated in due course. The polyembryonic rootstocks being used in the present studies are known to reduce the size of the scion tree.

Out of a total collection of 32 cultivars of mango growing at the Fruit Research Station, Gurdaspur, two cultivars namely, Totapari Red small and Krishan Bhog have been observed to be short statured. It is felt that if these are used as an interstock between ordinary mango seedling and scion may reduce the size of the scion tree. Fourteen plants of each combination have been propagated and their performance will be observed in due course in comparison to seedling Dusheri combination plants.

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H-3.3 (G) i : Fertilizer trial on Mango

G.S. Nijjar and Sohan Singh

This trial was initiated during 1966 to find out the most economic fertilizer dose(s) for mango. The experimental details are as under :-

Cultivar = Dusheri

System of planting = Square

Planting distance = 9 x 9 meters

Experimental design = R B D

Number of treatments = 12, Viz.

N = 100, 200 and 300 gm N/tree/year age

P_2O_5 = 0, 50 gm P_2O_5 per tree per year age

K_2O = 0, 100 gm K_2O per tree per year age

Replications = Six

Total No. of experimental trees = 12 x 6 x 1 = 72

Note :- The fertilizer dose shall be stabilized at the age of 10 years

During the year under report the plants received sixth year fertilizer dose. The data recorded on tree height, trunk girth and tree volume are presented in Table 60. Different fertilizer treatments failed to produce significant difference in height and volume of three trees. As regards the trunk girth, N_3P combination proved significantly better than all other treatments and registered a girth of 47.5 cm. The minimum girth was observed in trees receiving N_2 treatment which comprised of 200 gm N/year age of the trees.

TABLE..60 : Effect of fertilizer treatments on the height, girth and volume of the mango trees

Treatment	Mean height (m)	Mean girth cm	Mean volume cubic meter
N_1	3.39	44.6	32.77
N_2	3.33	38.1	23.53
N_3	3.67	45.1	31.56
N_1 P	3.36	40.2	23.61
N_2 P	3.68	46.0	33.11
N_3 P	3.78	47.5	37.73
N_1 K	3.74	45.7	33.07
N_2 K	3.82	44.3	33.04
N_3 K	3.30	36.0	24.08
N_1 PK	3.97	42.7	28.32
N_2 PK	3.65	44.9	31.36
N_3 PK	3.57	46.6	34.48
C.D. at 5% level of significance	N S	0.52	N S

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H-3.3 (GI) i : Fertilizer trial on mango cv. Dushari

G.S. Mijjar and J.S. Kanwar

The objective of this trial is to find out a suitable combination of NPK for obtaining maximum yield of high quality fruits in Dushari mango. The experimental details are as under :-

Fertilizer dozo :

N	:	100, 150 and 200 gm per tree per year of age
P_2O_5	:	25, 50 and 75 gm per tree/year of age
K_2O	:	50, 75 and 100 gm per tree/year of age

Those doses are to be stabilised at the age of 10 years.

Replications	:	Three
Plant Unit per treatment	:	Three
No. of experimental plants	:	243
Experimental design	:	3 factorial
Planting distance	:	10 x 10 m

The plant material for this trial has been planted in the field. Some gaps which have resulted due to mortalities, shall be filled in August, 1976.

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H-3.3 (L) i : Effect of N, P and K on growth, cropping and quality of Mango (cv. Dushori)

G.S. Mijjar, J.S. Arora and Gurcharan Singh

In order to find out the optimum doses of N, P and K for Dushori mango, a field trial was initiated in September, 1971 with the following experimental details :-

Fertilizer doses (g/plant/year age of the tree)

N	100	200	300
P_2O_5	100	200	-
K_2O	100	200	-

Replications	3
Plant Unit	1

Experimental Design R B D

Treatments 12

Treatment combinations

	N	P_2O_5	K_2O
T_1	100	100	100
T_2	100	100	200
T_3	100	200	100
T_4	100	200	200
T_5	200	100	100
T_6	200	100	200
T_7	200	200	100
T_8	200	200	200
T_9	300	100	100
T_{10}	300	100	200
T_{11}	300	200	100
T_{12}	300	200	200

The doses will be made constant during 1981.

The data on yield, fruit size, quality and tree diameter were recorded in July, 1975 and are presented in Table 61. From the data in the table it is evident that treatment T_1 (N_{100} P_{100} K_{100}) gave the highest yield per tree (71.04 kg), whereas the lowest yield (2.69 kg) was recorded when treatment T_{12} (N_{300} P_{200} K_{200}) was applied showing that there was improvement in the yield even without the application of fertilizer. There was no significant increase in the fruit size and quality under any of the treatments applied. Highest fruit weight (214.0 g), length (11.07 cm), breadth (5.95) and pulp weight (181.00 g) was obtained under T_7 (N_{200} P_{200} and K_{100}) treatment. Highest T S S value (20.80%)

TABLE 61 : Effect of N, P and K on growth, cropping and quality of mango - Cv. Dusheri

Treatment	Yield (kg)	Fruit size			Physico-chemical characters				Trunk diameter cm
		Fruit wt. g	Length cm	Breadth cm	T S S %	Pulp Wt. g	Stone Wt. g	Peel Wt. g	
T_1	71.04	158.0	9.27	5.28	19.66	134.83	14.33	8.33	19.30
T_2	55.01	148.6	9.51	5.43	18.33	119.89	16.55	12.22	17.62
T_3	44.62	159.0	10.01	5.34	18.80	135.33	14.42	9.25	17.85
T_4	50.[illegible]	166.0	9.04	5.19	20.20	133.08	18.58	13.33	18.70
T_5	48.58	155.3	9.65	5.33	19.80	130.00	18.58	6.42	17.22
T_6	36.19	162.6	10.14	5.64	20.20	135.11	17.75	9.72	17.16
T_7	25.54	214.0	11.07	5.95	20.00	181.00	18.50	13.50	14.69
T_8	55.73	142.3	9.55	5.34	19.00	121.33	13.50	7.50	16.66
T_9	65.58	170.3	10.29	5.62	20.80	140.00	17.88	12.44	17.13
T_{10}	46.16	153.0	9.80	5.72	19.20	180.82	11.87	10.25	14.58
T_{11}	16.59	158.2	10.15	5.56	20.53	134.04	15.44	8.41	13.05
T_{12}	2.66	130.5	9.60	4.93	19.53	114.16	9.35	7.00	12.50

was recorded with the application of T_{10} treatment (N_{300} P_{100} K_{200}). Stone and pulp weight of the fruit reduced according to the size of the fruit.

Highest trunk diameter (10.30 cm) was recorded from the trees which were supplied with T_1 treatment (N_{100} P_{100} K_{100}) whereas the lowest trunk diameter (12.50 cm) was recorded when T_{12} treatment (N_{300} P_{200} K_{200}) was applied.

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New Project : Survey to judge the mineral nutrition status of mango orchards in the Punjab.....

G.S. Nijjar, Satish Kumar and Ajit Singh

This project was initiated in April, 1976 in order to assess the nutritional status of mango orchards of the State. Twenty two orchards located in Gurdaspur district were surveyed and some 43 leaf samples of important cultivars, i.e., Dusheri, Langra, Fazri, Chausa and Bombay Green were collected from these orchards. Soil samples from these orchards were also collected. The leaf samples have since been analysed for their N, P and K contents (Table 62) whereas analyses for other macro and micro-elements was yet under way.

Mean values of N,P and K for different cultivars were found to be in the satisfactory range as compared with the standard optimum values. However, considering the individual leaf samples, in case of nitrogen, five samples of Dusheri, four of Langra, one of Chausa and one of Bombay Green, were found to be below the standard optimum value. In case of P and K, all samples from different cultivars were found to be above the standard optimum range. It is interesting to mention here that out of twenty two orchards surveyed six were never given any manure or fertilizer,

seven were supplied with little quantity of farm-yard-manure only, five were applied with nitrogen only in the form of urea or CAN and only four orchards were supplied with N, P and K fertilizers. The estimated yield was very good, good and poor in the orchard supplied with N, P, K and N only and no fertilizer, respectively.

TABLE 62 : Leaf N, P and K content of different mango cultivars of Gurdaspur district

S.No.	Cultivar	No. of samples	N	P	K
			Per cent dry matter		
1-	Dushari	17	1.63	0.112	0.403
2-	Langra	9	1.55	0.122	0.459
3-	Fazri	6	1.67	0.110	0.405
4-	Chausa	7	1.67	0.123	0.518
5-	Bombay Green	4	1.61	0.135	0.455
	Standard optimum values (Kenworthy and Martin)		1.54	0.055	0.097

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New Project : Nutritional status of mango trees in relation to biennial bearing

G. S. Nijjar, Satish Kumar and Ajit Singh

In order to see the relationship between biennial bearing and nutrient status of mango trees, this research project was initiated this year. Leaf samples were collected during October, 1975 and April, 1976 from ten trees each of Langra and Dushari. These samples have since been analysed for their N, P and K contents and are currently being processed for other micro and macro elements. The data for N, P and K or

presented in Table 63.

TABLE...63 : Average N, P and K values in Dushori and Langra leaves collected in October, 1975('On'year) and April, 1976 ('off' year)

Cultivar	N	P	K
	Per cent dry matter		
	October, 1975		
Dushori	1.78	0.14	0.67
Langra	1.70	0.14	0.66
	April, 1976		
Dushori	1.75	0.14	0.64
Langra	1.68	0.14	0.64

A perusal of the data in the above Table reveals that there was no difference in P and K contents of Dushari and Langra mango leaves collected in October, 1975 ('On' year) and April, 1976 ('off' year). The nitrogen content in Langra mango leaves was, however, slightly lower in both the timings.

The experiment would be repeated in the coming years, to obtain clear-cut and definite results.

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H-3.11 (L) i : Biology and control of mango pest (Mango hopper)

J.S. Khangura and G. S. Sandhu

Spray trial for the control of mango hopper

A spray trial with seven insecticides, viz. malathion 0.04%, monocrotophos 0.025%, fenitrothion 0.025%, carbaryl 0.1%, methyl parathion 0.025%, leptophos 0.025% and chlorpyriphos 0.025% was conducted on Dushari

mango trees. All the insecticidal treatments proved significantly better than control, but among the insecticidal treatments malathion proved less effective than other insecticides. Similarly carbaryl, fenitrothion, monocrotophos and methyl parathion were significantly better than chlorpyriphos, but carbaryl and methyl parathion also proved significantly better than lofotophos.

Mango survey

During the year under report a survey of the mango growing areas of the state was also conducted. As a result of this survey 22 superior quality seedlings were selected and their plants were grafted at Fruit Research Station, Gangian to be used as progeny trees. Progeny trees of 10 more superior seedling trees which had been propagated earlier were planted in the field.

Nursery production work :

Nursery production work was continued and the following numbers of plants of different species were raised for distribution among farmers.

Pear : Patharnakh	=	5789
Pear : Bagugosha	=	609
Peach : Flordasun	=	2368
Nectaine Sun Red	=	98
Citrus fruits	=	1031
Ber	=	277

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4 - P L U M

H-4.1 (B) i : Varietal-cum-fertilizer trial on plum

M.R. Gupta and Research Assistant

To find out suitable varieties of plum and best dose of nitrogen, a varietal-cum-fertilizer trial was planted at the Fruit Research Station, Bahadurgarh (Patiala) in February, 1967.

Plum cultivars = Four

V_1 = Titron

V_2 = Ladakh

V_3 = Zardalu

V_4 = Alubukhara Sharbati

Nitrogen levels = Four

T_1 25 g 'N' on per year age of the tree

T_2 50 g 'N' on per year age of the tree

T_3 75 g 'N' on per year age of the tree

T_4 100 g 'N' on per year age of the tree

Replications = 3

Tree Unit = 3

Experimental trees = 4 x 4 x 3 x 3 = 144

Growth data with respect to trunk girth, height and spread were recorded during January, 1976 and are presented in Table 64.

The results show that significant differences were observed in trunk girth, height and spread of trees in different cultivars, but there were no significant differences for these characters under different nitrogen levels. Highest trunk girth (69.7 cm), tree height (4.15 m) and spread (6.16 m) were observed in cv. Alubukhara Sharbati and lowest trunk girth (52.2 cm), tree height (3.70 m) and spread (4.96 cm) were observed in Ladakh.

TABLE 64 : Effect of nitrogen levels on the growth of different cultivars on Plum during 1975-76

Treatments	Titron (V_1)			Ladakh (V_2)			Zardalu (V_3)			Alubukhara Sharbati			Average of treatments		
	Trunk girth (cm)	Height (m)	Spread (m)	Trunk girth (cm)	Height (m)	Spread (m)	Trunk girth (m)	Height (m)	Spread (m)	Trunk girth (m)	Height (m)	Spread (m)	Trunk girth (m)	Height (m)	Spread (m)
T_1 (25 g N)	50.3	4.1	5.4	55.0	3.5	4.7	59.0	3.9	5.7	73.0	4.5	6.2	61.6	4.0	5.50
T_2 (50 g N)	55.3	4.2	5.9	47.7	3.5	4.9	51.7	3.6	5.3	69.3	4.4	6.3	56.0	4.0	5.60
T_3 (75 g N)	43.0	3.7	5.1	53.0	3.8	5.4	56.3	4.0	5.5	73.0	4.6	6.2	57.0	4.0	5.56
T_4 (100 g N)	57.3	3.3	4.9	50.0	3.8	4.9	50.0	3.4	4.9	63.7	4.3	6.0	55.2	3.7	5.16
AVERAGE	53.7	3.83	5.33	52.2	3.70	4.96	54.2	3.76	5.37	69.7	4.45	6.16			

C.D. at 5%	Cultivars	N Levels
Trunk girth	7.15	N S
Height	0.35	N S
Spread	0.65	N S

TABLE .... 65 Effect of Nitrogenous fertilizer treatments on the yield T S S and acidity of different plum cultivars

Treatments	Nitron (V_1)			Laddkh (V_2)			Zardalu (V_3)			Alubukhara Sharbati (V_4)			Average of treatments		
	Yield (kg)	T S S (%)	Acidity (%)	Yield (kg)	TSS (%)	Acidity (%)	Yield (kg)	TSS (%)	Acidity (%)	Yield (kg)	TSS (%)	Acidity (%)	Yield (kg)	TSS (%)	Acidity (%)
T_1 (25 g N)	25.3	12.5	2.81	44.3	13.1	1.37	82.7	11.6	0.83	23.3	13.0	2.04	44.0	12.6	1.76
T_2 (50 g N)	35.7	12.2	2.58	61.0	13.7	1.30	61.7	11.2	0.89	30.0	14.2	2.02	48.0	12.8	1.70
T_3 (75 g N)	47.7	12.6	2.68	59.0	13.5	1.23	74.3	11.6	1.09	49.3	13.7	2.06	57.6	12.8	1.84
T_4 (100 g N)	17.3	12.1	2.60	63.7	13.7	1.28	42.0	11.6	1.41	24.7	14.5	2.06	37.0	12.9	1.87
Average	32.25	12.3	2.67	57.00	13.5	1.30	65.16	11.50	1.13	31.83	13.85	2.08			

		Cultivars	'N' Levels
C.D. at 5% for	Yield	11.29	13.07
	T S S	0.56	N S
	Acidity	0.18	N S

Significant differences were observed in different plum cultivars in respect of fruit yield, T S S and acidity (Table 65). The highest average yield (65.16 kg per tree) was obtained in Zardalu and lowest yield (31.83 kg per tree) was obtained in Alubakhara Sharbati, which was on a par with Titron (32.25 kg per tree). Different N levels showed significant differences for fruit yield. The highest yield (57.6 kg per tree) was obtained under T_3 (75 g N) which was significantly greater than obtained under T_4 i.e. 100 g N per tree.

The highest T S S (13.8 %) was obtained in Alubukhara Sharbati and lowest (11.5%) in Zardalu. Highest acidity (2.67%) was obtained in Titron and lowest (1.13%) in Zardalu. Different levels of nitrogen did not show any significant differences with respect to fruit T S S and acidity. However, the highest acidity (1.87%) was obtained under T_4 (100 g N level) and lowest (1.70%) under T_2 (50 g N level).

**

H-4.1 (BT) i : Varietal collection and evaluation of plum

N.S. Tomar and Jagdayal Singh

The trial was initiated in January 1974 to select suitable varieties for commercial cultivation in arid-irrigated regions of Punjab. A collection of twenty varieties of plums comprising four plants each, had been completed in January 1975. Five more cultivars of plums were added to this collection during January, 1976.

The data recorded on the girth and canopy volume (recorded in August, 1975) as well as in regard to sprouting, flowering and fruit setting, etc. are given in Table 66.

TABLE 66 : Growth and flowering of different varieties of plum

Sr.No.	Variety	Av. girth (cm)	Canopy volume (m^3)	Date of first flower opening	Date of sprouting	Remarks
1-	Kelsey Japan	18.68	0.90	9/3	9/3	1 to 20 Nos planted in Jan. 1974
2-	Alucha Red	20.90	1.56	2/3	25/2	
3-	Kabul Greengage	10.93	0.99	24/2	22/2	
4-	Black Early	12.65	1.05	19/2	18/2	
5-	Damson	12.57	0.76	7/3	3/3	
6-	Zard-Alu-Red	12.05	0.63	4/3	27/2	
7-	Zard-Alu-Yellow	14.80	0.73	4/3	29/2	
8-	Alucha Large Yellow	3.87	0.03	10/3	22/2	
9-	Prunus simon	6.20	0.10	8/3	8/3	
10-	Excelsior	11.33	0.46	10/3	8/3	
11-	Santa Rosa	8.65	0.41	-	6/3	
12-	Alfa	9.68	0.49	2/3	26/2	
13-	Satsuma	10.93	0.51	-	1/3	
14-	Howe	9.40	0.07	9/3	6/3	
15-	Red Tifron	9.40	0.64	-	2/3	
16-	Kala Peshawari	13.95	0.77	-	26/2	
17-	Dabba	-	-	-	1/3	
18-	Kala Amritsari	-	-	-	24/2	
19-	Kala Local	11.68	0.68	3/3	24/2	
20-	Ladakh	7.05	0.34	4/3	27/2	
21-	Early Round	-	-	-		Planted in Jan.1976
22-	Dwarf Early Yellow	-	-	-		-do-

Contd...

23- Leto Yellow	-	-	-	Planted in Jan.,1976
24- French Red	-	-	-	-do-
25- Alubukhara	-	-	-	-do-

Alucha Red cultivar of plum showed maximum girth (20.90 cm) as well as Canopy size of the tree (1.56 m^3). Alucha Large Yellow was observed to be slow in growth where girth and canopy size were recorded 3.87 cm and 0.03 m^3 respectively (Table 66).

Fourteen out of the twenty varieties planted in January,1974 flowered this year. Black Early variety was observed the earliest to flower (February 19). and Alucha Large yellow and Excelsior were the last (March 10) under Bhatinda conditions. Black Early was also the earliest to sprout (February 18) whereas Kelsey Japan sprouted last of all (March 9).

**

H-4.1 (BT) ii : Varietal trial on plum

N.S. Tomar and Jagdayal Singh

With a view to find out suitable variety/varieties for the arid-irrigated region of Punjab, a varietal trial on plum was planted in January,1974.

The details of the experiment are as under :-

Varieties	:	Six, viz. Alubukhara, Ladakh, Titron, Zardalu, Kataru Chek and Lalri.
Replications	:	Four
Plant Unit	:	Three
No. of experimental trees	:	6 x 4 x 3 = 72

Spacing : 6 m x 6 m

Experimental design : R B D

The data recorded on the girth, canopy volume of the tree, date of sprouting, flowering, fruit setting, etc. are presented in Table 67.

TABLE 67 : Growth and flowering of different varieties of plum

Varieties	Girth (cm)	Canopy volume (m^3)	Date of flowering			Date of sprouting	Date of Fruit setting
			First	Last	Duration (days)		
Ladakh	21.12	1.95	17/2	5/3	17	12/2	26/2
Zardalu	18.34	1.19	12/2	28/2	16	15/2	9/3
Alubukhara	19.90	1.46	29/2	17/3	17	27/2	10/3
Lalri	14.87	0.89	12/2	4/3	21	12/2	23/2
Titron	17.04	1.68	11/2	23/2	12	10/2	21/2
Kataru Chak	14.35	0.81	11/2	25/2	14	13/2	24/2
C.D. at 5%	3.51	0.64	-	-	-	-	-

N.B. The data on girth and canopy volume of the tree are based on the observations taken on Ist August 1975 and canopy volume was calculated by the formula (width^2 x height)/4 as reported by Wutscher and Shull (1976).

Growth of trees

Data in Table 67 reveal that the girth of the plants of Ladakh was maximum and significantly better than that of Lalri, Titron and Kataroo Chak. Plants of Kataroo Chak showed poor growth and attained a maximum girth. No statistical difference in girth of Zardalu, Alubukhara and Titron was observed.

Canopy volume of Ladakh was recorded maximum and significantly better than Zardalu, Lalri and Kataroo Chak whereas Alubukhara and Titron

varieties were on a par with Ladakh. Minimum canopy volume was attained by the trees of Kataroo Chak.

Flowering period

During the year 1976, all the varieties came into flowering. The variety Titron and Kataroo Chak were the earliest to flower and Alubukhara was last under Bhatinda conditions. Flowering duration in case of Titron variety was shortest (12 days) whereas in Lalri it was largest (21 days).

Leaves emergence

The perusal of the data reveals that Titron is the earliest to sprout (February 10). The varieties Ladakh, Alubukhara and Titron sprouted prior to flower whereas in case of Kataroo Chak it was the other way. In Lalri variety leaves and flowers appeared simultaneously.

Fruit setting

Titron was observed to be early in fruit setting and Zardalu and Alubukhara were last to set fruit

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H-4.3 (L) i : Monurial trial on plum (Cv. Titron)

K.K. Sharma and G.S. Nijjar

The plant material for this trial was planted in February, 1972 The differential fertilizer treatments were given in February, 1976. The experimental details are as follows :-

Cultivar : Titron
Experimental Design: R B D
Treatments :

N (Four) N_1 (25 gm per year age of the plant) = 75 gm N
N_2 (50 gm per year age of the plant) = 150 gm N

	N_3 (75 gm per year age of the plant)	= 225 gm N
	N_4 (100 gm per year age of the plant)	= 300 gm N
P_2O_5 (Two)	P_1 (25 gm per year age of the plant)	= 75 gm P_2O_5
	P_2 (50 gm per year age of the plant)	= 150 gm P_2O_5
K_2O (Two)	K_1 (25 gm per year age of the plant)	= 75 gm K_2O
	K_2 (50 gm per year age of the plant)	= 150 gm K_2O

Replications	Nine
Plant unit	One
Number of experimental plants	16 x 9 = 144

The data recorded on growth and fruit quality are presented in Table 68. The data show that the trunk diameter and spread of the plants was significantly affected by the differential fertilizer doses. The height of the plants was, however, not significantly affected by any treatment.

The trunk diameter (8.03 cm), height (3.86 m) and spread (2.45 m) was the greatest in the N_3 P_1 K_1 treatment and the lowest trunk diameter (1.87 cm) and height (1.80 m) was recorded under the N_4 P_2 K_2 treatment.

The highest average fruit weight and size were obtained with N_4 P_1 K_1 treatment. The lowest average fruit weight and size were recorded in the N_3 P_1 K_2 treatment. The highest T S S (14.8%) was obtained with N_1 P_2 K_1 and acidity (2.06%) under the N_2 P_1 K_2 treatment.

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TABLE...68 · The effect of NPK combination on tree vigour and fruit quality in Plum - Cv. Titron

Treatment	Height (m)	Trunk diameter (cm)	Spread (m)	Av. Fruit Weight (gm)	Av. Fruit Length (cm)	Av. Fruit Breadth (cm)	T S S %	Acidity %
N_1 P_1 K_1	2.24	5.88	2.15	10.0	2.52	2.71	13.5	1.12
N_1 P_1 K_2	2.49	6.91	2.23	10.5	2.54	2.72	14.0	1.70
N_1 P_2 K_1	2.51	6.81	2.14	11.6	2.75	2.80	14.8	1.66
N_1 P_2 K_2	2.51	6.84	2.15	10.5	2.64	2.70	13.5	1.31
N_2 P_1 K_1	2.40	6.15	2.25	11.4	2.70	2.76	13.0	1.66
N_2 P_1 K_2	2.49	6.91	2.17	9.0	2.46	2.55	12.6	2.06
N_2 P_2 K_1	2.47	6.67	1.99	9.8	2.45	2.60	14.0	1.70
N_2 P_2 K_2	2.28	5.74	2.06	11.4	2.67	2.75	14.4	1.66
N_3 P_1 K_1	2.86	8.03	2.45	12.0	2.70	2.78	14.0	1.50
N_3 P_1 K_2	2.55	6.27	2.24	7.5	2.35	2.35	14.0	1.50
N_3 P_2 K_1	2.17	5.05	2.22	8.5	2.40	2.45	14.4	1.50
N_3 P_2 K_2	2.29	5.29	2.04	12.2	2.75	2.85	13.0	1.50
N_4 P_1 K_1	2.66	6.84	2.42	12.4	2.78	2.85	13.0	0.93
N_4 P_1 K_2	2.37	5.63	2.01	12.2	2.78	2.80	13.6	1.66
N_4 P_2 K_1	2.79	7.40	2.36	10.0	2.55	2.61	14.5	1.70
N_4 P_2 K_2	1.80	4.87	2.24	10.0	2.60	2.65	15.0	1.31
C.D. at 5%	S	2.04	0.15					

H-4.7 (L) i : To find out suitable varieties of plum for commercial cultivation in Punjab.

Ajit Singh Dhatt, S.S. Gill and M.P. Singh

During the year 1976, 24 collections came into flowering. The Titron was the earliest to bloom and the mill variety Burbank the last. Due to inclement weather, the flowering was delayed as compared to the last year. The hailstorm caused a heavy damage to the flowers of Katerou Chek and Titron. There was good over-lapping of the effective bloom in different sub-tropical varieties.

The physico-chanical analysis of the fruit was conducted in the varieties bearing sizable crop (Table 69). The average fruit wt. was 20.5 g in Alu Bokhara and the smallest fruits (10.1 g) were borne by yellow Gurdaspur. The highest T S S (17.0 per cent) was recorded in Golden Lalri which is a poor yielder.

Not much variation was observed in acid content of different varieties. All the plums are sub-acid to taste, except Golden Lahi which has relatively more sugar content.

The variety Kala Selection 2 gave maximum yield of 20.5 kg per plant which was followed by Alu Bokhara, Kala Selection 3 and Katerou Chek in descending order. Under local conditions, these plums starts ripening in the first week of May and harvesting is over by Ist week of June in the sub-tropical plums.

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TABLE ...69 : Physico-chemical characteristics of some plum cultivars

S.No.	Variety	Yield kg/tree	Av.Fruit wt.(g)	Fruit size cm. Length/Breadth	T S S %	Acidity %	Taste	Period of harvesting
1-	Kataroo Chek	15.2	13.3	2.73/2.92	11.4	0.86	Sub-acid	Ist week,May
2-	Kala Selection 2	20.5	12.4	2.56/2.68	12.0	0.81	-do-	2nd week, May
3-	Kala Selection 3	18.2	12.0	2.61/2.64	11.8	0.81	-do-	-do-
4-	Alu Bokhara, Ferozepur	19.0	16.2	2.83/3.00	11.0	0.97	-do-	3rd week,May
5-	Yellow Gurdaspur	8.0	10.1	2.43/2.38	10.4	0.87	-do-	4th week, May
6-	Golden Lalri	8.0	12.2	2.62/2.68	17.0	0.78	Moderate Sweet	-do-
7-	Ladakh	12.5	20.5	3.13/3.20	13.4	0.97	Sub-acid	Ist week,June
8-	Alucha Amritsar	4.0	11.3	2.53/2.48	12.5	0.83	-do-	Ist week,May

5 - PEACH

H-5.1 (BT) : i : Varietal collection and evaluation of peach

N.S. Tomer and Harish Kumar

In order to select suitable variety/varieties for commercial cultivation in arid-irrigated regions of Punjab, a comprehensive collection of peaches has been established. Twenty-five peach varieties comprising four plants of each, were planted upto January 1975 and ten more cultivars have been added to this collection during January, 1976.

The data recorded on the growth attributes in August 1975 as well as in respect of dates of flowering; leaves emergence, setting, etc. on twenty cultivars are presented in Table 70. The other fifteen cultivars were got too young.

The data show that the girth was maximum of the plants of Jewel variety whereas it was minimum in case of Peach Dwarf. However, the highest canopy size of tree was recorded in Surkha (3.85 m^3) followed by Bidwell's Early (3.78 m^3), Japanese Double (3.76 m^3), Jewel (3.40 m^3). Dwarf varieties of peach like June Gold and Peach Dwarf showed minimum canopy volume (0.11 m^3).

All the twenty varieties except Alexander and Perigreen planted in January, 1974 flowered this year and varieties Bidwell's Early and China Flat Large were the first to flower (January 25) while Honey Sweet flowered last (March 9). Bidwell's Early variety was noted to be earliest in sprouting (January 25) and Perigreen was last to sprout (March 20).

TABLE -.70 : Growth and flowering of different varieties of peach

Sr. No.	Variety	Girth (cm)	Canopy volume (m^3)	Dates of Flower starting	Dates of Leaves emergence	Re
1-	Jewel	24.4	3.40	12/2	14/2	Plant durin Janua 1974
2-	Alexandria	11.6	0.49	-	18/3	"
3-	Juno Gold	9.7	0.11	8/3	27/2	"
4-	Golden Trdasure	16.4	0.47	7/3	29/2	"
5-	Perigreen	16.7	1.06	-	20/3	"
6-	Elberta	17.7	2.31	30/1	30/1	"
7-	C.O. Smith	15.4	1.04	29/2	27/2	"
8-	Japanese Double	21.6	3.76	4/2	4/2	"
9-	Honey Sweet	21.0	2.68	9/3	6/3	"
10-	Sufeda L.R. Brothers	15.5	1.70	4/2	9/2	"
11-	Sufeda Free Stone	17.8	1.95	9/2	11/2	"
12-	Waldo	15.6	1.25	31/1	29/1	"
13-	Dr. Hogg	18.4	2.27	11/2	11/2	"
14-	Bidwell's Erly	22.7	3.78	25/1	25/1	"
15-	Khurmani	15.5	1.58	10/2	10/2	"
16-	China Flat Large	21.1	2.41	25/1	26/1	"
17-	Surkha	20.9	3.85	26/1	29/1	"
18-	China Flat	20.5	2.64	2/2	10/2	"
19-	Chekli	20.4	2.80	28/1	30/1	"
20-	Peach Dwarf	8.6	0.11	10/2	3/2	"

H-5.1 (BT) 11 : Varietal trial on peach

N.S. Tomar and Jagdayal Singh

With a view to study the performance of six peach cultivars under the agro-climatic conditions of Bhatinda (Punjab) a trial with the following details was planted in January, 1974.

Cultivars : Six, viz. Matchless, Peshawari Gola, Sunred, Sufeda, Sharbati and Flordasun.

Replications : Four

Plant unit : Three

No. of exptl. trees : 6 x 4 x 3 = 72

Spacing : 6 m x 6 m

Experimental Design : R B D

The data recorded on the girth, canopy volume of tree, date of sprouting, flowering, fruit setting, etc. are presented in the Table 71.

TABLE.71 : Growth and flowering of different varieties of peach

Variety	Girth (cm)	Canopy volume (m^3)	Flowering dates			Leaves emerging date	Fruit setting date
			Initition	End	Duration (days)		
Matchless	26.92	4.175	23/1	2/3	39	21/1	20/2
Sufeda	26.21	4.008	23/1	4/3	41	23/1	22/2
Sharbati	22.75	3.168	30/1	8/3	38	8/2	26/2
Peshawari Gola	26.83	4.190	19/1	26/2	38	22/1	14/2
Sunred	25.81	3.638	1/2	6/3	34	5/2	25/2
Flordasun	26.43	3.950	7/2	6/3	28	4/2	23/2
C.D. at 5%	N S	N S	-	-	-	-	-

N.B. The data on girth and canopy volume of the tree are based on the observation taken during Ist week of August 1975 and canopy volume was calculated by the formula (width^2 x height)/4

Growth of the trees

It is evident from the data that girth as well as canopy volume of the trees of all the varieties were statistically on a par.

Flowering Period

During the year 1976, all cultivars came into bearing. Cv. Peshawari Gola was the earliest to flower followed by Matchless Sufeda, Sharbati and Sunred and Flordasun flowered last of all. Duration of flowering was the maximum in Sufeda (41 days) and the shortest in Flordasun (28 days).

Leaves emergence

The Matchless was the earliest to sprout. Leaves appeared prior to flower in Matchless and Flordasun. Sharbati, Peshawari Gola and Sunred flowered 3 to 9 days prior to sprouting. Leaves and flowers appeared simultaneously in Sufeda variety.

Fruit setting

Peshawari Gola was observed to be early in fruit setting whereas Sharbati was last to set fruit. All the cultivars bore some amount of fruit for the first time.

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H-5.3 (L) Effect of nitrogen, phosphorus and potassium on the growth, yield and quality of Sharbati Peach (P. persica B.)

Satjit Singh Grewal and Gurcharan Singh

In order to find out the optimum doses of N, P and K for Sharbati Peach, a fertilizer trial was initiated in March, 1972 with the following experimental details :-

Fertilizer doses	g/year age of the tree		
N	50.0	100.0	150.00
P_2O_5	25.0	50.0	-
K_2O	50.0	100.00	-

Treatments	12
Replications	3
Plant Unit	2
Experimental Design	R B D

Data regarding the physical characters of fruit, quality and nutrients status in the leaves are given in the Table 72.

From the data, it is evident that treatment N_2 P_1 K_2 gave the highest fruit yield (30.7 kg) which was significantly more from all other treatments. Fruit weight (61.2 g) was the highest under treatment N_3 P_1 K_2 and it was significantly greater than all other treatments except N_2 P_1 K_2 treatment which gave the second highest value for fruit weight (57.9 g). Highest fruit size (5.2 x 4.7 cm) and pulp/stone ratio (9.7) was recorded under N_3 P_1 K_2 treatment showing that highest level of nitrogen (150 g) and potassium (100 g) influenced the size and pulp/stone ratio. However, this treatment did not differ significantly from all other treatments. Fruit quality was not affected significantly by any of the treatments applied. However, highest T S S (17.9 %) was obtained under N_2 P_1 K_2 and highest acidity (0.35 %) was recorded under N_3 P_1 K_2 treatment, showing the effect of high doses of nitrogen (150 g) and potassium (100 g).

Nutrient status in the leaves did not differ significantly under any of the treatments applied. Highest leaf value for N was recorded under N_3 P_1 K_1 treatment showing that uptake of nitrogen was increased from the soil under low phosphorus and potassium application. Similarly the leaf phosphorus was increased (0.15 % P_2O_5) under N_1 P_2 K_1 treatment showing that uptake of P_2O_5 was increased under low N and K_2O application. Highest value of K_2O (3.85%) was recorded under N_1 P_2 K_2 treatment showing that high Phosphorus did not hinder the uptake of potassium from

TABLE ..72 . Effect of different fertilizer treatments on yield, fruit quality and foliage N, P and K content

Treatment	Yield (kg)	Fruit weight (g)	Size		Pulp/stone ratio	T S S	Acidity %	Leaf		
			L	B				N	P	K
N_1 P_1 K_1	12.7	42.6	4.63	4.71	8.4	16.4	0.33	3.78	0.14	3.5
N_1 P_1 K_2	16.4	54.7	5.00	4.56	8.8	16.0	0.31	3.76	0.13	3.8
N_1 P_2 K_1	13.0	51.5	4.85	4.40	9.0	16.1	0.26	3.81	0.15	3.7
N_1 P_2 K_2	16.1	48.3	4.77	4.32	9.0	16.1	0.24	3.80	0.15	3.8
N_2 P_1 K_1	16.2	53.9	4.88	4.46	9.2	16.3	0.34	3.89	0.13	3.6
N_2 P_1 K_2	30.7	57.9	5.11	4.60	9.3	17.2	0.24	3.88	0.13	3.8
N_2 P_2 K_1	20.4	54.7	5.06	4.58	8.9	16.4	0.26	3.91	0.13	3.7
N_2 P_2 K_2	18.7	52.4	4.87	4.42	8.8	16.6	0.30	3.90	0.14	3.7
N_3 P_1 K_1	14.6	51.9	4.89	4.48	9.1	16.1	0.26	3.96	0.12	3.2
N_3 P_1 K_2	13.3	61.2	5.27	4.71	9.7	16.7	0.35	3.92	0.12	3.1
N_3 P_2 K_1	14.2	55.5	5.05	4.56	9.2	15.1	0.32	3.98	0.12	3.1
N_3 P_2 K_2	16.0	53.8	5.00	4.58	9.1	16.2	0.29	3.93	0.12	3.
C.D. at 5%	4.34	4.09	N S	N S	N S	N S	N S	N S	N S	N

the soil whereas high application of N may had antagonistic effect to the K_2O.

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H-5.7 (L) i : To find out the varieties of peach suitable for commercial cultivation in the Punjab

H.N. Khajuria, S.S. Gill, M.P. Singh
and Y.R. Chanana.

Collection

To the previous collection, a few more cultivars like June Elberta and some local strains from Jammu region of Jammu and Kashmir State were added. The collection now consists of 40 cultivars and strains.

Studies on performance

The performance of the local cultivars which have come into bearing was studied. They include Sharbati Red, Chakli, Peach Khurmani, Matchless Jewel, Sufeda, Ranjit Bagh Early, Killi Kranti and Honey Sweet. Some of the fruit and characters are given in Table 73.

Among all the peach cultivars Ranjit Bagh Early was the first to ripen i.e. by the middle of May while all thers ripened in June.

Sufeda out-yielded others with 30.40 kg/tree av. yield, followed by Jewel. Both of these cultivars have shown promise as table peaches. However, Jewel being completely a free-stone, has an edge over Sufeda. The cultivar Sharbati Red too is a free-stone with a large fruit. It has a firm flesh of peach colour and is suitable for canning. Its major drawback is the high acidity of 1.13 of which mars its acceptability as a table peach.

Some flowering and fruiting were also recorded in some cultivars

TABLE...7 : Physico-chemical characters of some Peach cultivars

Sr.No.	Name of the variety	Av.yield per tree (kg)	Av.wt. of fruit (g)	Av. length of the fruit (cm)	Av. breadth of fruit (cm)	T S S (%)	Acidity (%)	Ripening date
1-	Sharbati Red	16	114	6.38	5.90	16.0	1.13	3.6.76
2-	Chakli	12.6	52.5	5.35	4.80	12.2	1.04	13.6.76
3-	Peach Khurmani	16.0	82.0	5.80	4.60	12.4	0.83	13.6.76
4-	Matchless	20.5	112	6.00	5.50	13.4	0.91	8.6.76
5-	Safeda	30.48	52.1	4.20	4.00	11.2	0.64	15.6.76
6-	Jowal	22.5	74.	5.70	4.50	13.8	0.44	13.6.76
7-	Ranjit Bagh Early	15.8	45.0	4.00	3.90	12.8	0.63	15.5.76
8-	Killi Kranti	13.5	72.5	5.28	4.5	12.40	0.68	12.6.76 *
9-	Honey Sweet	12.8	43.5	4.8	4.0	10.20	0.40	18.6.76

* First bearing

in the collection block. Among these, the cultivar White Knight-2 showed the desirable characters. It is a table peach with white flesh and a free stone. It matures in the middle of May and thus appears promising.

Hybridization Work

As a result of hybridization attempted during 1974-75, some 500 seeds of F_1 hybrids were obtained. From these seeds, only 80 seedlings could be obtained. It has been noted that inter-cultivar crosses with Flordasun as a seed parent, yield seeds with a very low germinating capacity. This problem of low germination of seeds is being probed into. The F_1 seedlings were planted in the field 2 m x 2m apart - during February, 1976. They were making good growth.

During spring 1976 season, the following crosses were attempted :-

S.No.	Femal Parent		Male Parent	No. of flowers crossed
1-	Sufeda	x	Flordasun	500
2-	Sharbati	x	Flordasun	1,000
3-	16 - 33	x	Flordasun	500
4-	Sun Red	x	Flordasun	200
5-	Sufeda	x	Sun Red	400

About 400 hybrid seeds have been obtained which have since been stratified.

**

6 - P E A R

H-6.2 (GN) : Rootstock trial on pear

J.S. Kanwar and Horticulturist

The object of this experiment is to find out the performance of Patharnakh and Baghugosha on different rootstocks and also to compare the performance of grafted plants with those raised from cuttings. The experimental details are as under :-

Rootstocks	:	Four, Viz. Pyrus pyrifolia Pyrus pashia Cydonia oblong D - 4 (A type of Kainth)
Scions	:	Patharnakh Baghugosha
Plant Unit/treatment	:	Three
Replications	:	Three
Total number of experimental plants	:	90
Experimental design	:	Split plot

The plant material was planted in the field in January, 1966.

**

H-6.2 (L) i : Rootstock trial on the pear (Pyrus communis L.)

Horticulturist and K.K. Sharma

In order to find out a suitable rootstock for important pear cultivars grown in the sub-tropical region, a rootstock trial was initiated at Ludhiana during February, 1967 with the following details :-

Rootstocks : Pathernakh (Pyrus pyrifolia)
Kainth (Pyrus pashia)

Scion cultivars : Smith, Leconte, Kieffer and Baghugosha

There were eight stock/scion combinations

T_1 Smith/Kainth

T_2 Leconte / Kainth

T_3 Kieffer / Kainth

T_4 Baghugosha / Kainth

T_5 Smith / Pathernakh

T_6 Leconte / Pathernakh

T_7 Kieffer / Pathernakh

T_8 Baghugosha / Pathernakh

Replications : Four

Plant Unit : Three

Total No. of plants : 8 x 4 x 3 = 96

Experimental design : R B D

The data recorded on the growth characters of different scion cultivars are summarized in Table 74. The growth of the cultivars was significantly affected on the rootstocks. The maximum height ([illegible] m) was recorded in Smith/Kainth and the minimum (3.16 m) in Kieffer/Pathernakh combination. Leconte and Smith on Kainth were having significantly more height than Leconte, Kieffer and Baghugosha on Pathernakh. Baghugosha on both the rootstocks was having a similar height.

Kainth stock girth under all the four cultivars was on a par. Similarly stock girth in Pathernakh under these cultivars was on a par. Kainth stock girth was the highest and Pathernakh stock girth the lowest under Leconte and Kieffer.

The scion girth of all the cultivars was more on Kainth than Patharnakh. Loconte and Kieffer had the maximum scion girth on Kainth the minimum on Patharnakh.

The highest spread (1.83 m) was observed in Loconte/Kainth and the lowest (0.84 m) in Kieffer/Patharnakh Smith, Kieffer and Baghugosha Kainth were on a par, in respect of their spread.

TABLE...74 : Effect of rootstock on the height, girth and spread of Pear cultivars on different rootstocks

Rootstock	Scion Cultivar	Height (m)	Stock girth (m)	Scion girth (cm)	Spread (m)
Kainth	Smith	4.74	11.53	9.54	1.55
	Loconte	4.36	12.18	10.90	1.83
	Kieffer	3.94	12.15	10.86	1.70
	Baghugosha	3.94	10.74	9.81	1.56
Patharnakh	Smith	4.17	11.35	7.92	1.26
	Loconte	3.49	8.22	6.49	1.14
	Kieffer	3.16	8.59	6.53	0.34
	Baghugosha	3.77	9.41	7.17	1.04
C.D. at 5%		0.56	2.43	1.40	0.17

**

H-6.3 (B) i : Varietal-cum-fertilizer trial on Pear

M.R. Gupta and Research Assistant

A varietal-cum-fertilizer trial on pear was planted in Februa 1967 with the following experimental details :-

Cultivars = Four, viz.,

V_1 = Pathernakh

V_2 = Leconte

V_3 = Smith

Nitrogen levels = Four, viz.

N_1 = 25 g 'N' on per year of the tree

N_2 = 50 g 'N' on per year of the tree

N_3 = 75 g 'N' on per year of the tree

N_4 = 100 g 'N' on per year of the tree

Experimental design = R B D

No. of replications = Three

Tree unit = Three

No. of experimental trees = 3 x 4 x 3 x 3 = 108

The data with respect to trunk girth, tree height and spread were recorded in February,1976 and fertilizer doses were applied after recording growth data in February,1976. Data for fruit yield, T S S and acidity on the 1975 crops were recorded earlier in July and August, 1975.

The growth data (Table 75) show that significant differences were observed for trunk girth and tree height in different pear cultivars but no significant difference was observed to tree spread. The highest trunk girth (50.5 cm) and tree height (5.85 m) were observed in Pathernakh and lowest trunk girth (38.1 cm) and tree height (4.41 m) were found in Smith and Leconte, respectively. Different nitrogen levels, failed to induce any significant differences in trunk girth, tree height and spread.

TABLE.76 : Effect of different nitrogen levels on the fruit yield of three pear cultivars during 1975-76

Treatment	Patharnakh (V_1) (Fruit No.)	Leconte (V_2) (Fruit No.)	Smith (V_3) (Fruit No.)	Average (Fruit
T_1 (25 g N)	133	431	419	328
T_2 (50 g N)	283	480	394	386
T_3 (75 g N)	167	415	526	369
T_4 (100 g N)	204	613	443	421
Average (no.)	197	485	446	357
Weight in kgs	24.64	44.55	60.21	

C.D. at 5% for cultivars (No) = 106

C.D. at 5% for N levels (No) = 64

The data on fruit yield show that significant differences were observed in the fruit number of different cultivars as well as under different nitrogen levels. Highest fruit yield (485 fruits per tree) w obtained under Leconte which were on a par with Smith (446 fruits). Lowe fruit number (197 fruits) per tree was obtained in Patharnakh with regard to total yield by weight, it was the highest in Smith (60.21 kg) followed by Leconte (44.55 kg) and lowest in Patharnakh (24.64 kg).

As regards fertilizer treatments, T_4 (100 g N) gave significant higher fruit number (421 fruits per tree) than T_1 where the fruits borne were 328 per tree (Table 76).

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TABLE....75 : Effect of different Nitrogen levels on the growth of three Pear cultivars during 1975-76

Treatment	Patharnakh (V_1)			Leconte (V_2)			Smith (V_3)			Average of treatments		
	Trunk girth (cm)	Height (m)	Spread (m)	Trunk girth (cm)	Height (m)	Spread (m)	Trunk girth (cm)	Height (m)	Spread (m)	Trunk girth (cm)	Height (m)	Spread (m)
T_1 (25 g N)	50.3	3.8	2.96	41.3	4.3	3.53	40.0	4.3	2.83	43.8	4.93	3.11
T_2 (50 g N)	47.0	5.7	3.63	38.3	4.3	3.00	32.0	4.1	2.10	39.1	4.70	2.91
T_3 (75 g N)	52.3	5.9	3.63	37.0	4.3	3.67	41.6	4.5	3.26	43.6	4.83	3.52
T_4 (100 g N)	52.3	5.9	4.06	40.3	4.6	3.87	39.0	4.7	3.46	43.8	5.96	3.80
Average	50.5	5.85	3.55	39.1	4.41	3.56	38.1	4.45	2.91			

C.D. at 5% levels

	Varieties	N levels
Trunk girth	4.98	N S
Height	0.33	N S
Spread	N S	NS

H-6.3 (L) i : Effect of graded doses of NPK on the vigour cropping and fruit quality of Patharnakh Pear

G.S. Nijjar, K.K. Sharma and H.R. Chopra

This project was initiated at Ludhiana during February, 1972. The differential doses of fertilizers were applied in February, 1976. Th details of the experiment as follows :-

Treatments :

N	N_1 (20 gm per year age of tree)	180 gm N
	N_2 (40 gm per year age of tree)	360 gm N
	N_3 (60 gm per year age of tree)	540 gm N
	N_4 (80 gm per year age of tree)	720 gm N
P_2O_5	P_1 (20 gm per year age of tree)	180 gm P_2O_5
	P_2 (40 gm per year age of tree)	360 gm P_2O_5
K_2O	K_1 (20 gm per year age of tree)	180 gm K_2O
	K_2 (40 gm per year age of tree)	360 gm K_2O

and NPK combinations

Plant Unit	One
Replications	Nine
Total No. of experimental plants	16 x 9 = 144
Experimental Design	R B D

The growth data recorded during February 1976 are given in Table 77. The growth of pear plants was not significantly affected by any of the treatments. The greatest trunk diameter (14.90 cm) and plant height (6.03 m) was, however, obtained under $N_2P_1K_1$ treatment. The lowest trunk diameter (12.22 cm) height (5.11 m) and spread (2.43 m) was recorded under $N_1P_2K_2$ treatment.

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TABLE...77 : Effect of NPK combinations on tree growth in Pear (Patharnakh)

Treatment	Trunk diameter (cm) (10 cm above soil)	Spread (m)	Height (m)
N_1 P_1 K_1	14.45	3.62	5.44
N_1 P_1 K_2	14.10	2.85	5.26
N_1 P_2 K_1	14.35	3.16	5.60
N_1 P_2 K_2	12.22	2.43	5.11
N_2 P_1 K_1	14.90	3.33	6.03
N_2 P_1 K_2	14.04	3.02	5.44
N_2 P_2 K_1	13.62	2.88	5.44
N_2 P_2 K_2	14.75	3.21	5.61
N_3 P_1 K_1	14.18	3.25	5.33
N_3 P_1 K_2	14.23	3.01	5.42
N_3 P_2 K_1	14.23	3.08	5.72
N_3 P_2 K_2	13.14	2.79	5.34
N_4 P_1 K_1	13.15	2.78	5.16
N_4 P_1 K_2	14.57	3.18	5.61
N_4 P_2 K_1	14.00	3.19	5.37
N_4 P_2 K_2	13.33	2.91	5.27
C.D. at 5%	N S	N S	N S

H-6.8 (L) i : Studies on the cold storage life of Patharnakh Pear

S.S. Mann, B.S. Dhillon and J.S. Randhawa

With a view to extend the post-harvest life of Patharnakh Pear fruits, the following pre-storage treatments were tried. The fruit in the cold storage was held at a temperature of 0 - 3.3°C with a relative humidity of 85 - 90 per cent during the year 1975.

T_1 = Direct storage

T_2 = Storage after treating the fruits with 0.2% Captan

T_3 = Storage after wrapping in polythene (200 gauge)

T_4 = Storage after wrapping in polythene (200 gauge) after treatment with 0.2% Captan

T_5 = Fruits packed as in T_3 but cold stored after 10 days of harvest

T_6 = Fruits packed as in T_4 but cold stored after 10 days of harvest

The physico-chemical analysis of the stored fruits were carried out after every 45 days. The total cold storage period was 135 days.

Among all the treatments, the refrigeration of Captan treated fruits in polythene wrappers proved to be the best as the spoilage recorded under this treatment was least (Table 78). The spoilage was highest when the fruits were refrigerated after 10 days of harvest in polythene wrappers and without Captan treatment. The storage life under this treatment did not exceed 90 days. In general, it was observed that the Captan treatment and the polythene wrapping had remarkable effect in checking the spoilage and the loss in weight respectively. The combination of the two as single treatment proved to be the best. The chemical composition of fruits under various treatments did not differ much.

TABLE..78 : Effect of various treatments on physico-chemical characteristics of Patharnakh pear during cold storage

Treatment	Loss in weight	Spoilage (%)	Reducing sugars (%)	Acidity (%)	T S S (%)
T_1	10.71	22.23	6.15	0.25	12.1
T_2	10.58	18.20	6.42	0.26	12.3
T_3	6.15	22.95	5.57	0.24	11.9
T_4	77.66	12.15	5.93	0.24	11.8
T_5	12.31	46.25	5.79	0.24	11.9
T_6	7.5	18.79	5.93	0.15	12.1

The data represents the mean of 45, 90 and 135 days of sampling dates

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8 - L I T C H I

H-8.2 (G) : Fruit Drop studies in Litchi

Sohan Singh and Horticulturist

Investigations on the effect of growth regulators in the control of fruit drop in litchi, cultivar Calcutta Late were carried out at the Fruit Research Station, Gurdaspur from 1968 to 1975. Three growth regulators viz. NAA, 2,4-D and 2,4,5-T were tried each at a concentration of 20, 40 and 60 ppm during 1968; 5,10 and 15 ppm during 1969 and 1971 and 2,3 and 4 ppm during 1972, 1973 and 1975. It was observed during these six years of study that the fruit drop was not reduced by the use of these chemicals, probably due to high temperature during April-May at the time of spray. The experiment has since been discontinued.

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H-8.3 (GN) i : Varietal-cum-fertilizer trial on Litchi

J.S. Kanwar and Research Assistant

This experiment is aimed at to find out the best combination of NPK for the three important litchi cultivars for obtaining maximum yield of high quality fruits.

Cultivars : Three, viz.

1- Calcutta Late
2- Seedless Late
3- Dehradun

Fertilizer Doses :

N : 50,100 and 150 gm per year of age
P_2O_5: 25, 50 gm per year of age
K_2O : 25, 50 gm per year of age

The fertilizer doses shall be stabilized at the age of 10 years.

Replications	:	Three
Plant Unit per treatment	:	Two
Total No. of experimental plants	:	216
Experimental Design	:	3 x 2 x 2 Factorial

The plant material for this experiment was planted in the field in September, 1975. Some mortalities have occurred due to transplanting shock and summer heat. These shall be replaced in September, 1976.

**

H-8.3 (G) i : Fertilizer trial on Litchi

G.S. Nijjar and Sohan Singh

The fertilizer trial on litchi was initiated during 1967 with the following experimental details :-

Cultivar	=	Calcutta Late
Planting distance	=	9 x 9 meters
Experimental design	=	Factorial
Replications	=	Three
Plant Unit	=	One
No. of treatments	=	27 viz.
		N = 50, 75 and 100 gm of actual nitrogen per tree per year age
		P_2O_5 = 0, 25 and 50 gm per tree per year age
		K_2O = 0, 25 and 50 gm per tree per year age
Total number of experimental plants	=	3 x 27 x 1 = 81

The plants were given the first fertilizer dose during April,1975. The plants in the first replication being six year old, received fertilizer dose of the sixth year, the plants in the second replication being four year old, received its fourth year fertilizer dose and the plants in the third replication received its third fertilizer dose being three years old. The data has been recorded on the trunk girth, height and spread of the trees. It can only be compared when the plants in the second and third replication attain the age of six years.

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H-8.12 (G) ii : Bearing in relation to growth in Litchi

Sohan Singh and Horticulturist

Studies on the bearing in relation to growth in three important cultivars, viz. Calcutta Late, Seedless Late and Dehradun were initiated during 1972. Two sets of growth in each cultivar viz. shoots appearing on the bearing branches of 1975 and those from non-bearing branches of 1975 were tagged during July,1975 to observe their performance in relation to fruiting during 1976. Twenty shoots of each cultivar in each category were tagged. The data on their performance are presented in Table 79. The data show that in cultivars Calcutta Late and Seedless Late many shoots which did not produce fruit during 1975, did not even flower during 1976 and continued growing. These results are not in agreement with the findings of the previous year. This may be due to unfavourable weather. Cultivar Dehradun also did not maintain its previous trend and the bearing branches of 1975 produced very little fruit during 1976 which is also not in agreement with the results obtained during 1975.

TABLE...79 : Effect of different types of growth on its fruiting behaviour in the subsequent seasons

Name of cultivar	February growth from terminals that did not carry fruit in 1975			Growth from terminals that carried fruit in 1975		
	No. of shoots observed	No. of fruitful shoots	%age fruitfulness	No. of shoots observed	No. of fruitful shoots	%age fruitfulness
Calcutta Late	20	6	30.00	20	14	70.00
Seedless Late	20	6	30.00	20	8	40.00
Dehradun	20	13	65.00	20	6	30.00

H-8.12 (G) iii : Studies on the establishment of Litchi

Sohan Singh and Horticulturist

Mortality of the young transplanted litchi plants is very high. To study this problem, a trial was initiated during 1970 with the following experimental details :-

Cultivars	=	Calcutta Late
Age of the plants	=	1, 2 and 3 years
Protection	=	Arhar (common for all)
Number of plants per treatment	=	Three
Replications	=	Six
Total number of experimental plants	=	3 x 3 x 6 = 54

One year old plants were transplanted during October, 1973 and gave 84 per cent success. Two year old plants were transplanted during October, 1974 which gave 93 per cent success. The three year plants will be transplanted during October, 1976 and its performance be observed in due course of time.

**

9 - DATES

H-9.9 (A) i : Thinning of date palm

M.S. Bajwa, S.K. Kalra and V.K. Vij

A trial on thinning of Khadrawi dates was started in 1975 to improve the quality of berries and to see if thinning could hasten maturity. Control, viz. no thinning (T_1) was compared with thinning by levelling of inflorescence at 5 cm from the tip before pollination (T_2), removal of one-third strands from terminal of the spadix in addition to levelling (T_3) and removal of one-third strands after fruit-set in addition to levelling treatment (T_4). The data in respect of effect of different thinning treatments on yield and maturity of Khadrawi dates are given in Table 80.

Thinning treatments reduced the total yield and did not hasten the maturity. It is proposed to try this experiment with more severe thinning treatments.

TABLE ..80 : Effect of thinning treatments on yield (kg) and maturity of Khadrawi dates

Treatment	Dang (%)	Doka (%)	Partial doka (%)	Green (%)	Waste (%)	Total (%)
T_1	0.715	4.864	1.660	0.590	3.466	11.295
T_2	1.259	3.577	2.107	0.439	3.227	10.609
T_3	0.896	2.865	1.451	0.410	2.135	7.757
T_4	0.513	2.436	1.490	0.658	2.845	7.945

**

H-9.9 (A) ii : Curing of dates - Loss of sugars during boiling

S.K. Kalra and S.K. Munshi

The loss of sugars from doka dates during boiling in wate for 2, 4, 6, 8, 10, 14 and 18 minutes wa determined to confirm the l year's results. One kg fruit of uniform size with the calyx intact was loosely tied in muslin and dipped in boiling water for respective periods of treatment in each of the four cultivars, viz. Hillawi, Medjool, Shamran and Khadrawi. One litre water was used every time fo boiling and final volume was made after taking out the berries by adding more water to compensate loss due to evaporation. The treatmen were replicated four times. Reducing, non-reducing and total sugars were estimated in the leachate which is equivalent to the per cent los of sugars on the basis of fresh weight of the doka used.

A perusal of the data in Table 81 shows that the more the duration of boiling, the greater was the loss of reducing, non-reducing and total sugars. The per cent loss due to boiling was maximum in Medjool. The loss of total sugars in this case for the 18-minute boiling treatment was 16.71 per cent and this was followed by that in Hilawi (9.28%), Shamran (8.58%) and Khadrawi (7.78). Medjool had also leached maximum reducing and non-reducing sugars.

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H-9. NP(A) : Rooting of aerial suckers in date-palm

M.S. Bajwa, V.K. Vij and S.K. Kalra

The date-palm produces a limited number of suckers during its life time. Some suckers are borne above the soil. These aerial suckers, being devoid of roots cannot be used for propagation. A trial

TABLE...81 : Effect of time of boiling on the leaching of sugars in different date cultivars (1975)

Treatment (Immersion time in boiling water in minutes)	Hillawi			Medjool			Shamran			Khadrawi		
	Reducing sugars (%)	Non-reducing (%)	Total sugars (%)	Reducing sugars (%)	Non-reducing (%)	Total sugars (%)	Reducing sugars (%)	Non-reducing (%)	Total sugars (%)	Reducing sugars (%)	Non-reducing (%)	Total sugars (%)
2	0.39	0.52	0.93	0.32	0.56	0.90	-	-	-	0.67	1.20	1.93
4	0.83	1.70	2.62	0.49	1.11	1.66	0.72	1.06	1.83	1.08	2.61	3.83
6	1.02	2.25	3.39	1.05	2.04	3.19	0.99	1.46	2.52	1.27	2.66	4.07
8	1.18	2.92	4.24	1.55	3.26	4.97	1.39	2.18	3.68	1.58	4.50	6.32
10	1.58	4.77	6.35	2.68	4.61	7.28	1.65	2.99	4.80	1.62	5.00	6.88
14	2.12	5.84	8.27	4.71	9.14	14.34	2.68	4.80	7.73	1.84	6.29	8.45
18	2.48	6.46	9.28	6.39	9.33	16.71	3.04	4.51	7.78	1.90	6.36	8.58

was initiated in October, 1975 in cv. Medjool to induce rooting on such aerial suckers. The following treatments were tried :-

1- Control - The aerial suckers were detached from mother palm and planted in the field as such.

2- The aerial suckers were detached from the mother palm and planted in the field after dipping for one minute in 1000 ppm IBA.

3- The aerial suckers were detached from the mother palm and planted in the field after dipping in 3000 ppm IBA for one minute.

4- Covering the basal part of offshoots still attached to the mother palm with wooden shavings enclosed in polyethelene sheet.

5- Covering the basal part of offshoots still attached to the mother palm with moss grass enclosed in polyethelene sheet.

The treatments were replicated six times.

Offshoots of approximately same size were selected for the purpose. The wooden shavings and moss grass were thoroughly saturated with water and the polyethelene tied at both the extremities so as not to allow any escape of moisture. No water was added till the termination of the experiment.

The results so far obtained have indicated that the offshoots planted in the field whether treated or untreated with IBA did not survive and all died in 4-5 months. The treatment 5 viz. moss grass gave the best results and emergence of roots could be seen through the polyethelene after about 3 months. The roots were also formed on the offshoots covered with wooden shavings. The observations recorded after detaching the plants in April, 1976 showed that the intensity and length of the roots was considerably lesser in wooden shaving than that in the moss grass treatment (Table 82). Also the emergence of roots was observed after five months.

TABLE ..82 : Rooting pattern of aerial suckers in dates - cv. Medjool

Treatments	Average length of the root (cm)	Average thickness of the root (cm)	Average weight of the root (g)
Polyethelene covering + moss grass	21.15	0.72	99.00
Polyethelene covering + wooden shavings	14.60	0.67	81.00

**

10 - G U A V A

H-10.3 (B) i : Effect of graded doses of N, P and K on the vigour, cropping and quality of guava

G.S. Nijjar, M.R. Gupta and Research Assistant

This trial was planted in August 1970 to study the effect of different levels of N, P and K fertilizers on the performance of guava - cv. Allahabad Safeda at the Regional Fruit Research Sub-station Bahadurgarh. These plants are grafted on L-49 rootstock. There are 2 treatments replicated four times with tree unit of three. The following doses of fertilizers are under study.

N = 40, 120 and 200 g per year age of the tree.

P = 100, 200 and 300 g of $P_2 O_5$.

K = 40, 120 and 200 g of K_2O.

Data with regard to fruit yield from both the rainy season and winter season crops were collected. Analysis of fruits for T S S and acidity was done during February, 1976 for winter season crop. Data with regard to tree girth, height and spread were recorded during June, 1976. Fifth year dose of fertilizer was added during the last week of June, 1975. Since the higher doses of fertilizers caused mortality in some plants, this trial has been closed. Growth data with regard to tree girth, height and spread are given in Table 83.

The results given in Table 83 show that there were significant differences with regard to trunk girth under different treatments. Trunk girth was significantly higher under $N_1 P_2 K_1$, $N_1 P_3 K_1$, $N_2 P_1 K_1$, $N_1 P_1 N_1 P_3 K_2$, $N_3 P_1 K_2$, $N_3 P_2 K_2$, $N_3 P_3 K_2$, $N_1 P_1 K_3$, $N_1 P_3 K_3$, $N_3 P_1 K_3$ & $N_3 P_3 K_3$ as compared to other treatments.

As regard tree height, there was no significant difference

among different treatments. However, the greatest height (3.68 m) was recorded under $N_1 P_3 K_1$ and the lowest (2.55 m) under $N_2 P_3 K_2$.

As regard the tree spread the differences were significant. Different other treatments gave significantly higher tree spread over $N_2 P_2 K_1$, $N_2 P_3 K_1$, $N_3 P_2 K_1$, $N_2 P_1 K_2$, $N_2 P_3 K_2$ and $N_1 P_2 K_3$ treatments.

TABLE...84 : Effect of N P & K on the fruit yield, T S S and acidity of guava - cv. Allahabad Safeda

Treatment		Total yield (Kg)	T S S (%)	Acidity (%)
1-		2-	3-	4-
T_1	$N_1 P_1 K_1$	43.37	8.60	0.43
T_2	$N_1 P_2 K_1$	39.27	9.00	0.44
T_3	$N_1 P_3 K_1$	46.72	9.50	0.45
T_4	$N_2 P_1 K_1$	48.77	8.90	0.43
T_5	$N_2 P_2 K_1$	47.20	9.10	0.41
T_6	$N_2 P_3 K_1$	42.07	9.00	0.42
T_7	$N_3 P_1 K_1$	35.82	8.75	0.43
T_8	$N_3 P_2 K_1$	39.37	9.50	0.44
T_9	$N_3 P_3 K_1$	50.72	9.30	0.45
T_{10}	$N_1 P_1 K_2$	47.50	9.20	0.46
T_{11}	$N_1 P_2 K_2$	51.57	9.70	0.42
T_{12}	$N_1 P_3 K_2$	50.10	8.90	0.43
T_{13}	$N_2 P_1 K_2$	39.80	9.10	0.44
T_{14}	$N_2 P_2 K_2$	37.67	9.70	0.40
T_{15}	$N_2 P_3 K_2$	50.27	9.50	0.45
T_{16}	$N_3 P_1 K_2$	52.80	10.0	0.43
T_{17}	$N_3 P_2 K_2$	38.97	9.85	0.42
T_{18}	$N_3 P_3 K_2$	49.97	9.15	0.44

Contd...

1-		2-	3-	4-
T_{19}	N_1 P_1 K_3	39.90	10.20	0.43
T_{20}	N_1 P_2 K_3	50.77	10.00	0.42
T_{21}	N_1 P_3 K_3	39.12	9.70	0.43
T_{22}	N_2 P_1 K_3	57.27	9.80	0.42
T_{23}	N_2 P_2 K_3	38.90	9.60	0.45
T_{24}	N_2 P_3 K_3	52.17	9.80	0.43
T_{25}	N_3 P_1 K_3	32.32	9.40	0.42
T_{26}	N_3 P_2 K_3	38.75	9.40	0.44
T_{27}	N_3 P_3 K_3	33.57	8.80	0.43
C.D. at 5%		N S	N S	N S

The data given in Table 84 show that there were no significant differences in total fruit yield from both crops due to different fertilizer treatments. However, highest fruit yield (57.27 kg) was obtained under N_2 P_1 K_3 and lowest (32.32 kg) under N_3 P_1 K_3 closely followed by N_3 P_3 K_3 treatment (33.57 kg).

There was no significant differences in T S S and acidity levels under different fertilizer combinations tried in this experiment.

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TABLE..83 : Effect of N P & K on the trunk girth, spread of guava - cv. Allahabad Safeda

Sr.No.	Treatments	Trunk girth (cm)	Tree Height (m)	Tree Spread (m)
1-	N_1 P_1 K_1	30.5	3.09	4.76
2-	N_1 P_2 K_1	34.7	3.27	4.37
3-	N_1 P_3 K_1	36.2	3.68	4.82
4-	N_2 P_1 K_1	35.5	3.29	4.81
5-	N_2 P_2 K_1	33.5	3.16	3.88
6-	N_2 P_3 K_1	30.7	2.90	3.69
7-	N_3 P_1 K_1	36.0	3.28	4.63
8-	N_3 P_2 K_1	32.7	2.98	4.23
9-	N_3 P_3 K_1	32.2	3.09	3.80
10-	N_1 P_1 K_2	38.0	3.38	4.68
11-	N_1 P_2 K_2	33.5	3.08	4.53
12-	N_1 P_3 K_2	36.5	3.37	4.40
13-	N_2 P_1 K_2	31.2	2.92	3.70
14-	N_2 P_2 K_2	34.2	2.98	4.27
15-	N_2 P_3 K_2	28.0	2.55	3.07
16-	N_3 P_1 K_2	38.0	3.37	4.42
17-	N_3 P_2 K_2	36.2	3.12	4.41
18-	N_3 P_3 K_2	35.7	3.24	4.58
19-	N_1 P_1 K_3	37.0	2.99	4.51
20-	N_1 P_2 K_3	31.5	2.65	3.53
21-	N_1 P_3 K_3	34.7	3.18	4.30
22-	N_2 P_1 K_3	33.5	3.07	4.25
23-	N_2 P_2 K_3	35.2	3.09	4.39
24-	N_2 P_3 K_3	35.5	3.16	4.35
25-	N_3 P_1 K_3	36.7	3.15	4.37
26-	N_3 P_2 K_3	34.2	3.12	4.47
27-	N_3 P_3 K_3	37.2	3.29	4.83
	C.D. at 5%	4.39	N S	0.88

H-10.7 (L) i : Improvement of guava through selection

Ajit Singh Dhatt, J.S. Jawanda and
Gurcharan Singh

A large number of open-pollinated guava seedlings of variety Safeda, Sardar Guava (Lucknow 49) and seedless are being screened. The 3-4-year seedlings are growing in nursery at a distance of 25-40 cm from plant to plant and row to row. During March-April, 1975 flowering was recorded on 298 plants. The number of flowers varied from 10 to 65 per seedling. Only ten flowers were retained on each plant. The fruits were small in size, did not ripen properly and were infected with fruit fly. The ripening of the fruits started in August. No winter crop was borne on any seedling.

During April, 1976 the number of flowering seedlings increased to 900. Only ten flowers, well spaced on various branches has been retained on each seedling and the rest removed.

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11 - B E R

H-11.2 (L) i : Rootstock trial on Ber

M.P. Singh and K.K. Sharma

A rootstock trial on Ber has been underway since 1968, to find some suitable rootstock(s). The following 14 rootstocks are included in this trial :-

1-	Z. mauritiana	(Katha from Punjab)
2-	Z. mauritiana	(Katha from Calcutta)
3-	Z. mauritiana	(Katha from Coimbatore)
4-	Z. mauritiana	(Globular from Dehradun, U P)
5-	Z. mauritiana	(Elongated from Dehradun, U P)
6-	Z. mauritiana	(Katha from Kaladungi, U P)
7-	Z. Jujuba	(Variety SI.AOTS40 from Kandaghat)
8-	Z. Oenoplia	(M P)
9-	Z. Zoaziroo	(Brazil)
10-	Z. Xylopyrus	(M P)
11-	Z. numularia	(Punjab)
12-	Z. numularia	(Rajasthan)
13-	Z. numularia	(Haldwani)
14-	Z. numularia	(Dehradun)

Scion	:	Umran
Replications	:	Four
Plant Unit	:	Three
Design	:	R B D
Experimental plants	:	168
Non-experimental plants	:	84
Total No. of plants:		252

The gaps of Z. mauritiana from Kaladungi and Z. Oenoplia rootstocks could not be successfully filled due to poor growth of the newly planted rootstocks. The growth data recorded on rest of the 12 rootstocks are summarized in Table 85.

The plants on Zizyphus mauritiana procured from different sources were vigorous as compared to rest of the rootstocks except on Z. mauritiana (Coimbatore), which were dwarf. The scion portion of plants on Z. numularia had greater diameter of scion than stock and were having inverted bottleneck union. The plants on Z. jujuba, Z. zoaziroo and Z. xylopyrus were also having more scion girth than their stock girth. The maximum stock (66.41 cm) and scion girth (62.06 cm) was recorded in plants budded on Z. m (Elongated from Dehradun). The minimum stock (11.00 cm) and scion (11.58 cm) girth was in plants on Z. zoaziroo.

The maximum plant height (3.16 m) and spread (5.20 m) was recorded in plants budded on Z.m (Globular from Dehradun) closely followed by Z. m (Katha from Punjab). The plants on Z. n (Rajasthan) were having more spread than those on Z. n from Punjab, Haldwani and Dehradun.

The plants on Z. m (Coimbatore) were having smooth union. They were less vigorous and low-headed.

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H-11.9 (L) : Spacing-cum-pruning trial on Ber

Horticulturist, M.P. Singh and K.K. Sharma

This trial was started during 1969 to find out the suitable planting distance and pruning severity for Umran cultivar of Ber. It includes four distance of planting, viz., 30' x 30', 25' x 25', 20' x 20' and 15' x 15' and four pruning treatments, viz., no pruning (T_1) 3/4th of

TABLE....85 : Growth of 7 year old Umran plants on 12 different rootstock

Rootstock	Girth (cm)		Plant height (m)	Plant spread (m)
	Stock	Scion		
1- Z. mauritiana (Punjab)	63.54	55.45	3.13	4.79
2- Z. m. (Calcutta)	52.69	51.46	2.96	4.43
3- Z. m. (Coimbatore)	32.66	31.44	2.16	3.37
4- Z. m. (Globular Dehradun)	61.29	58.87	3.16	5.20
5- Z. m. (Elongated Dehradun)	66.41	62.06	3.10	4.67
6- Z. jujuba (SIAOTSAO)	29.08	31.58	2.62	4.46
7- Z. Zoaziroo	11.00	11.58	1.11	1.25
8- Z. xylopyrus (M P)	12.44	12.75	1.29	0.83
9- Z. numularia (Punjab)	31.98	34.50	2.40	3.17
10- Z. n. (Rajasthan)	46.00	48.75	2.22	4.07
11- Z. n. (Hal)	33.75	36.79	2.31	3.20
12- Z. n. (Dehradun)	34.55	40.68	2.62	3.52
C.D. at 5%	12.87	11.92	1.21	1.36

previous year's growth removed (T_2) $\frac{1}{2}$ removed (T_3) and $\frac{1}{4}$ removed (T_4). There are three trees per treatment in each of the four replications. Thus there are 192 experimental plants.

Tree Height

The data in Table 86 show that the height of the trees was significantly affected by different spacings. The height was significantl greater in trees planted at 15' x 15' distance than those planted at other distances. The height of the trees under different pruning intensities was not affected statistically.

TABLE.....86 : Spacing-cum-pruning treatments on the Height of 'Umran' ber trees

Spacing	Pruning treatments				Mean
	T_1	T_2	T_3	T_4	
30' x 30'	3.45	3.05	3.09	3.30	3.22
25' x 25'	3.56	3.75	4.07	3.17	3.64
20' x 20'	3.74	3.48	3.71	3.91	3.71
15' x 15'	3.75	3.94	3.79	3.64	3.78
Mean	3.62	3.53	3.89	3.50	

C.D. at 5%

for spacing = 0.35
for prunings = N S
for spacing x pruning = N S

Girth

The trunk girth was significantly affected by different spacings and pruning treatments. (Table 87). The maximum trunk girth (73.88 cm) was observed where trees were planted at 25' x 25' and the minimum (56.10 c

in 30' x 30' planting distance. The trunk girth was on a par in 30' x 30', 20' x 20' and 15' x 15' plantations. The girth was the highest (67.12 cm) where no pruning was given and the lowest in T_4 where only $\frac{1}{4}$th of the new growth was removed.

TABLE...87 : Effect of spacing-cum-pruning treatments on the girth of 'Umran'ber trees

Spacing	Pruning treatment				Mean
	T_1	T_2	T_3	T_4	
30' x 30'	64.75	52.68	48.58	58.40	56.10
25' x 25'	86.15	71.14	75.17	63.06	73.88
20' x 20'	56.47	61.50	59.37	52.02	57.34
15' x 15'	61.11	57.51	67.17	54.53	60.08

C.D. at 5%

for spacings = 9.52

for pruning = 2.09

for spacing x pruning = N S

Spread

The spread of Umran trees was significantly affected by spacings and pruning treatments (Table 88). The spread was significantly more where planting distance was 25' x 25' than 30' x 30' and 15' x 15'. The spread was significantly higher in T_1 (no pruning) treatment, as compared to other three pruning treatments.

The maximum spread (8.00 m) was observed in 30' x 30' planting distance and T_1 (no pruning) treatment, followed by that of 25' x 25' distance and T_1 (no pruning) treatment. The minimum spread (5.24 m) was

noticed in 15' x 15' planting distance and where only $\frac{1}{4}$ of the new growth was removed.

TABLE...88 : Effect of spacing-cum-pruning treatments on the spread of 'Umran' ber trees

Spacings	Pruning treatments				Mean
	T_1	T_2	T_3	T_4	
30' x 30'	8.06	4.77	5.21	5.44	5.36
25' x 25'	7.98	7.17	7.39	5.84	7.09
20' x 20'	6.10	6.98	6.39	6.30	6.44
15' x 15'	5.46	5.48	6.04	5.24	5.55

C.D. at 5%

for spacing = 0.92

for prunings = 0.13

for spacing x pruning = 0.25

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12 - POMEGRANATE

H-12.1 (L) : Varietal collection and evaluation of Pomegranate

J.S. Jawanda, H.N. Khajuria, M.P. Singh
and S.S. Gill

So far 24 cultivars have been collected from various sources. Almost all the varieties collected have come into flowering and fruiting. The flowering was observed to take place in the month of April except in cv. Bedana which started flowering by the end of March. By the 3rd week of April, almost all the varieties had flowered completely and a few like Bedana and Dholka had set the fruits also.

The number of the fruits borne by different varieties was recorded (Table 89). The cultivar Anar Malas had the highest number of fruits per plant, followed by the cultivars Gulerhals, Dholka and Kazkai. Studies on the incidence and extent of cracking showed that cultivars Suni Bedana, Seedless, Chole Selection 1 and Dholka were highly prone to cracking trouble as 80.0 to 86.6 per cent fruits were found cracked in their case. On the other hand, fruit cracking was the lowest in A K Anar, Anar Alah, Anar Malas, etc. The physico-chemical analysis of the fruits will be carried out at the time of complete ripening.

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TABLE...89 : Average number of fruits produced by different varieties of Pomegranate

S.No.	Name of the Variety	Average No. of fruits/plant		
		Total	Cracked	%age cracked
1-	Bedana	16	7	43.7
2-	Seedless	5	4	80.0
3-	Kandhari Saharanpur	10	2	20.0
4-	Dholka	18.3	13.3	72.7
5-	Afphan Kandhari Seedling	1.7	0.3	17.6
6-	Kandhari	1	0.5	50.0
7-	Suni Bedana	11	9.3	84.6
8-	Achikdaner	5.3	1.3	15.7
9-	Surakh Anar	10.7	2.3	21.5
10-	Shirin Anar	17.3	3.7	21.4
11-	Kali Shirin	1	-	-
12-	Kazil Anar	5.7	1	17.5
13-	Anar Alak	8	1	12.5
14-	Bashi Kalinski	7.5	2.5	33.3
15-	Anar Post-e-Sefid	2.7	1	37.0
16-	Guleshah	23.7	11.7	49.4
17-	Ak Anar	1.7	0.7	4.1
18-	Anar Shrin Mohamad Ali	4	1.3	32.5
19-	Kazkar	18	7.7	37.8
20-	Anar Tabestari Tagrish	17	5.5	32.5
21-	Anar Malas	28.5	4	14.0
22-	Chola Selection -I	4.5	2	44.4
23-	Chola Selection -II	3	2	66.6

H-13.11 (L) II : Biology and control of insect pests of stone fruits

J. S. Khangura and G. S. Sandhu

(A) Efficacy of dormant and after fruit-set spray for the control of peach leaf curl aphid

A spray trial with dimethoate, chlenpyriphes, monocrotophos and oxydemeton methyl with two dosages i.e. 0.05% and 0.03% and two methods of application, viz. ultra low volume and high volume was conducted on Sharbati cultivar of peach. All the treatments were equally effective in controlling the pest than control, except that dimethoate 0.05% in ultra low volume application technique, proved less effective.

(B) Efficacy of granulas application for the control of peach leaf curl aphid

Granular application of dimethoate, carboguran, disulfotam, phorate and aldicarb with three dosages viz. 0.5, 1.00 and 1.5 kg per hectare was done at the time of flowering. All the treatments proved equally effective in controlling the pest and were significantly better than control.

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TABLE ..90 : Efficacy of dormant vs. after fruit set spray for the control of peach leaf curl aphid

Sr.No.	Treatments	Method	Dose	Population of peach leaf-curl aphid on 8 twigs 10 cm at various intervals (mean of 3 replications)/~~n+1~~						
				Dormant spray			After fruit set spray			
							Before spray	After spray		
				17.3.76	25.3.76	31.3.76		17.3.76	25.3.76	31.3.76
1	2	3	4	5	6	7	8	9	10	11
1-	Chlorpyimphos	ULV	.03	1.33 (1.41)*	0.00 (1.00)	0.67 (1.24)	4.33	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
2-	Chlorpyimphos	ULV	.05	0.67 (1.24)	0.67 (1.24)	0.67 (1.24)	4.00	0.33 (1.14)	0.00 (1.00)	0.00 (1.00)
3-	Chlorpyimphos	HV	.03	0.67 (1.27)	0.33 (1.14)	0.00 (1.00)	4.67	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
4-	Chlorpyimphos	HV	.05	4.00 (2.21)	0.00 (1.00)	1.67 (1.62)	4.67	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
5-	Dimethoate	ULV	.03	1.00 (1.38)	0.67 (1.27)	1.00 (1.38)	4.33	0.33 (1.14)	0.33 (1.14)	0.33 (1.14)
6-	Dimethoate	ULV	.05	2.67 (1.86)	0.33 (1.14)	0.33 (1.14)	3.67	2.67 (1.67)	9.33 (2.57)	19.00 (3.32)
7-	Dimethoate	HV	.03	0.67 (1.24)	0.00 (1.00)	0.67 (1.24)	4.67	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
8-	Dimethoate	HV	.05	2.00 (1.71)	0.00 (1.00)	0.33 (1.14)	4.33	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
9-	Monocrotophos	ULV	.03	0.67 (1.27)	0.00 (1.00)	0.33 (1.14)	4.33	0.00 (1.00)	0.33 (1.14)	0.00 (1.00)

1	2	3	4	5	6	7	8	9	10	11
10-	Monocrotophos	ULV	.05	0.67 (1.27)	0.33 (1.14)	0.33 (1.14)	4.00	0.00 (1.00)	0.33 (1.14)	1.67 (1.48)
11-	Monocrotophos	HV	.03	1.00 (1.38)	0.67 (1.27)	0.00 (1.00)	3.90	0.00 (1.00)	0.33 (1.14)	0.67 (1.27)
12-	Monocrotophos	HV	.05	1.00 (1.33)	0.67 (1.27)	0.00 (1.00)	3.80	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
13-	Orcy-demeton methyl	ULV	.03	0.33 (1.14)	9.67 (1.24)	0.67 (1.27)	3.79	0.33 (1.14)	0.33 (1.14)	0.00 (1.00)
14-	Orcy-demeton methyl	ULV	.05	1.00 (1.33)	0.00 (1.00)	0.67 (1.27)	3.33	0.00 (1.00)	0.33 (1.14)	0.00 (1.00)
15-	Orcy-demeton methyl	HV	.03	0.33 (1.14)	0.00 (1.00)	0.33 (1.14)	4.33	0.00 (1.00)	0.33 (1.14)	0.00 (1.00)
16-	Orcy-demeton methyl	HV	.05	0.00 (1.00)	0.33 (1.14)	0.00 (1.00)	4.67	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
17-	Control	-	-	6.33 (2.70)	5.67 (2.58)	10.33 (3.16)	4.67	5.67 (2.57)	8.33 (3.05)	10.00 (3.31)
	C.D. (P=0.05)			0.51	0.36	0.65	N S	0.63	0.97	1.47

* Figures in the paren-thesis are $\sqrt{n+1}$

ULV and HV stands for ultra low volume and high volume respectively

TABLE...91 : Efficacy of different insecticides for the control of peach leaf curl aphid

Sr.No.	Treatment	Dose kg a.i./ha	Population of peach leaf curl aphid on 8 twigs 10 cm each at various intervals (mean of replications)/$\sqrt{n+1}$	
			11.3.76	8.4.76
1-	Aldicarb	0.5	1.67 (1.58)*	0.00 (1.00)
2-	Aldicarb	1.00	0.67 (1.14)	0.00 (1.00)
3-	Aldicarb	1.5	0.33 (1.14)	0.00 (1.00)
4-	Carbofuram	0.5	0.33 (1.14)	0.33 (1.14)
5-	Carbofuram	1.00	0.33 (1.14)	0.00 (1.00)
6-	Carbofuram	1.5	0.67 (1.24)	0.00 (1.00)
7-	Dimethoate	0.5	0.67 (1.27)	0.00 (1.00)
8-	Dimethoate	1.00	0.33 (1.14)	0.33 (1.14)
9-	Dimethoate	1.5	0.33 (1.14)	0.00 (1.00)
10-	Disulfoton	0.5	0.33 (1.14)	0.33 (1.14)
11-	Disulfoton	1.00	1.00 (1.38)	0.00 (1.00)
12-	Disulfoton	1.5	0.67 (1.27)	0.00 (1.00)
13-	Phorate	0.5	0.00 (1.00)	0.00 (1.00)
14-	Phorate	1.00	0.33 (1.14)	0.00 (1.00)
15-	Phorate	1.5	1.33 (1.52)	0.00 (1.00)
16-	Control	-	21.67 (4.74)	17.67 (4.13)
	C.D. (P=0.05)		1.17	0.25

* Figures in the parenthesis are/$\sqrt{n+1}$

EXTENSION EDUCATION

The activities undertaken in the field of horticulture extension education during 1975-76 are given below :-

I Farm Advisory Service Scheme

This is one of the principal channels to carry out the horticulture extension programmes throughout the State all the year round. The main object of this scheme is to feed the growers with technical guidance in raising fruit crops successfully, dimseminate the latest research findings amongst growers and to collect and bring the field problems in horticulture back to the research workers for finding their suitable solutions. Such programmes are carried out through the District Extension Specialists (Horticulture) posted at all the district headquarters of the Punjab and Union Territory of Chandigarh. The work done for the overall development of horticulture in the State during the year under report is explained itemwise as under :-

1- Training Camps :- During rabi and kharif seasons 16 district level training camps organised at different locations in the State were participated by the extension staff in horticulture. In these camps problems of the fruit growers were discussed with them and necessary solutions were recommended to improve the condition of their fruit plantations. In addition to the above camps the District Extension Specialists (Horticulture) participated in 71 block level and 37 village level camps organised in their respective areas. In these camps the growers were told about the importance of planting fruit trees on their tubewells. Apart from these, 4 charcha mandal camps were also attended by the District Extension Specialists (Horticulture). In these camps

also fruit tree planting programmes were discussed with the participants. The total number of participants benefitted from these camps was 12,304. The detailed information about the number of growers who attended these camps in different districts is given in Table 92.

2- Demonstration on Horticultural Operations :- In order to impart, on the spot guidance to the fruit growers, the District Extension Specialists (Horticulture) organised demonstrations on different horticultural operations on the growers fields in their respective areas. Emphasis was laid on the operations of specialised nature like pruning and training of grapes, peaches and other deciduous fruits growing in the State. So much so that 48 demonstrations were arranged on grapes alone throughout the State. Mass scale demonstrations on other cultural practices like digging and filling of pits, planting of saplings, protection of plants against natural hazards etc. were also arranged to educate the growers about these operations. The total number of growers who were benefitted by 161 demonstrations was 3,343. The details of these demonstrations are given in Table 93.

3- Area brought under fruit plants : With the strenous efforts of horticulture extension staff 705.5 acres of new area was brought under fruit cultivation during the year under report in the State. Fruitwise coverage is shown in Table 94.

4- Demonstration centres : Demonstration centres of fruit plantation are being maintained in all the districts of the State by the District Extension Specialists (Horticulture) in order to educate the farmers by way of "Seeing in believing". At present 28 such centres are in operations throughout the Punjab and all out efforts are being made to get the recommended horticultural practices adopted at these centres. The record of management of these centres is being properly

TABLE..92 : Number of training camps organised during 1975-76

	District	No. of camps organised	Participants
District Level	Sangrur	3	550
	Kapurthala	2	700
	Amritsar	2	850
	Jullundur	3	1,022
	Gurdaspur	1	80
	Ferozepur	3	3,300
	Hoshiarpur	2	845
		Total	7,347
Block Level	Sangrur	10	650
	Patiala	12	539
	Kapurthala	8	320
	Amritsar	8	300
	Jullundur	5	291
	Ferozepur	6	370
	Hoshiarpur	21	895
	Chandigarh	1	30
		Total	3,395
Village level	Patiala	13	805
	Jullundur	5	155
	Gurdaspur	2	80
	Ferozepur	2	112
	Hoshiarpur	15	410
		Total	1,562
Charcha Mandal	Patiala	4	293
		Total	293

TABLE...93 : Demonstrations on various horticultural operations held on growers field during 1975-76

District	Operation	No. of demonstrations	No. of participants
Ferozepur	Pruning of grapes	6	61
	Application of manures & fertilizers	7	78
	Digging and filling of pits	6	1,426
	Budding of ber plants	2	17
	Spraying of fruit trees	5	83
Ropar	Training and pruning of grapes	5	50
Sangrur	Training and pruning of fruit plants	11	190
	Manuring of fruit plants	17	231
Kapurthala	Pruning and training of grapes	5	67
	Other horticultural operations	6	115
Patiala	Training and pruning of peaches	2	9
	Training and pruning of pears	1	8
	Pruning of grapes	3	19
	Pruning of Ber	2	14
	Orchard cultural practices	20	215
Amritsar	Pruning of grapes and other horticultural operations	16	286
Jullundur	Laying out of new orchards	1	21
	Training & pruning of deciduous plants	7	98
Hoshiarpur	Training & pruning of grapes, peaches and pears	12	138
Chandigarh	Pruning and training of grapes and other horticultural operations	27	220
	Total.....	161	3,343

TABLE...94 : Area brought under different fruit trees during 1975-76

District	Area in acres										
	Ber	Grapes	Peach	Pears	Plums	Guava	Mango	Citrus	Litchi	Mixed	Total
Ropar	4	-	10	8	11	25	15	-	-	25	98
Kapurthala	1	4	2	2	-	-	-	-	-	3	13
Patiala	18	-	35	-	30	13	32	20	-	-	148
Amritsar	-	-	125	125	-	-	-	-	-	-	250
Jullundur	-	2	3.5	31	-	1	1	9.5	-	4	52
Gurdaspur	-	-	-	60	10	-	20	-	10	-	100
Ferozepur	-	-	-	5	10	-	1.5	-	-	-	16.5
Hoshiarpur	-	-	8	10	-	-	-	10	-	-	280
Total	22	6	180.5	236	61	38	69.5	39.5	10	32	705.5

maintained in the office of the F.A.S.S. in order to assess the progress.

5- Tubewell plantation : The work of planting fruit trees on tubewells sites was continued with the same vigour as in previous years. Field days on tubewell plantation compaign were organised by the District Extension Specialists (Horticulture) in their respective areas in planting season. A large number of farmers attended these programmes. Demonstrations on digging and filling of the pits and actual planting of trees were arranged to educate the farmers. As a result of keen efforts of the horticulture extension staff 6,792 tubewells were covered with 40,325 fruit trees in the State. The details of tubewell plantation work are given in Table 95. In addition to the above tubewell plantation work 2,251 fruit plants of different kinds were planted in home gardens mainly in Chandigarh.

TABLE...95 : Number of fruit plants planted on the tubewells under Tubewell Plantation programme

District	No. of tubewells covered	No. of fruit plants planted
Ropar	150	750
Kapurthala	48	366
Patiala	243	2044
Hoshiarpur	150	575
Jullundur	5723	33081
Gurdaspur	300	2410
Ferozepur	151	936
Chandigarh	27	163
Total	6792	40325

6- Advisory Visits : In order to render on the spot guidance in fruit culture, the horticulture extension staff made more than 1,150 visits to the different orchards in the State. The farmers showed a keen interest in learning the new methods and techniques from the experts. In addition to this Professor of Horticulture (Extension) paid several visits to various districts to accelerate the extension activities of the District Extension Specialists (Horticulture) and also guide the orchardists on horticultural problems on the spot.

7- Rejuvenation of old and neglected orchards : Each District Extension Specialist (Horticulture) has been looking one or two neglected unproductive orchards growing commercially in their respective districts. The orchard owners are advised to follow the recommended package of practices. It has given very good results in improving the general condition and bearing of the orchards. The records of various operations used, improvement in health and yield are being maintained in the office of the Farm Advisory Service Scheme. The progress made by the orchards after the adoptation of the recommended horticultural practices is worth appreciation.

8- Training to Junior Staff School :- The horticulture extension staff posted at Ludhiana continued to impart training in the subject of horticulture to the classes held by the Junior Staff School, like Agriculture Sub-Inspectors Class, Teachers Training Class, Young Farmers Class and visiting groups of other States.

9- Beautification of public places and farm houses : The District Extension Specialists (Horticulture) also carried out the work of ornamental plantation at farm houses to make these places aesthetically charm looking. Assistant Extension Specialist (Landscaping) posted at Ludhiana rendered

technical guidance to schools and public institutions in regard to landscape plants and their execution. The interested persons were also told in detail the plant material used in landscaping and its availability from the different nurseries of the State.

10- Refresher training programme for the District Extension Specialists (Horticulture) :-

To acquaint the horticulture extension staff posted at each district headquarters with the latest practical as well as theoratical aspects of training and pruning of deciduous fruit plants grown in the State, three refresher courses of one day duration each were arranged at Kandaghat (Simla), Ludhiana and Gangian (Hoshiarpur) on 2nd, 6th and 7th of January,1976 respectively. All the District Extension Specialists (Horticulture) attended these programmes. The horticulture staff of the Department of Agriculture of the concerned states were given the practical demonstration of these operations in the orchards. The refresher courses proved very useful for the horticulture extension workers for handling such demonstrations on the growers fields for the benefit of the fruit growers of their areas.

11- Field Days :

(A) Ber Field Day : A ber field day was organised at the Regional Fruit Research Sub-station, Bahadurgarh on 22nd March,1976. More than 400 leading fruit growers of the State participated and showed a great enthusiasm. They were taken round the full bearing Ber orchard in order to see the heavy bearing trees themselves. The experts of the horticulture department delivered talks on the various aspects of ber cultivation and control of insect pests and diseases of ber. Rana Moti Singh, Senior Vice-Chairman of the Punjab Pradesh Congress Committee and a member of the Board of Management of the Punjab Agricultural University also attended the function and addressed the gathering. The function was

presided over by Dr. M.S. Randhawa, Vice-Chancellor. It was a grand success.

(B) Peach Field Day : A field day on peaches was organised on May 12,1976 at Ludhiana. The bearing habit and pruning of Flordasun pe was the main topics of discussion. The bearing trees were a sight to b seen. The field day was attended by the Horticulture Development Offic District Extension Specialists (Horticulture) and Assistant Horticultur of Fruit Research Stations of the Punjab Agricultural University. Cha Balram Jakhar, Deputy Irrigation and Power Minister, Punjab, was also present on this occasion and was shown the performance of the newly introduced peach varieties. The Professor and Head, Department of Horticulture explained the proper method of pruning of peaches. He further disclosed that there was a problem of overbearing of Flordasun peach in plains to the participants and thus needed more pruning. Prop pruning, therefore, was essential to regulate the production and improve the quality of fruit. Dr. A. S. Dhillon, Director of Extension Educatio Punjab Agricultural University emphasised the need of pruning and thinni of the peaches. He then went along the participants round the peach tr and explained the problems in peaches to the participants. The function was a great success.

(C) Grape field Day : To show the performance of grape varieties, to educate the grape growers and to discuss the problems relating to the production and marketing of grapes, one grape field day was organised a Punjab Agricultural University on 22nd of June,1976. All the District Extension Specialists (Horticulture) alongwith about 300 grape growers from all over the State attended this programme. The Vice-Chancellor presided over this function. Detailed discussions were held on various

aspects of grape culture and best possible solutions were suggested by the specialists. The participants were taken round the vineyard to see the grapes bearing on different systems of training. The head system of training was very much appreciated by the growers. Fruit of different varieties of grapes was also displayed in the orchard for the testing and tasting of the participants. The function was a real success.

(D) Grape Show : The 8th State Level Grape Show was held in the Khalsa College for Women, Ludhiana on 22nd and 23rd of June,1976. The function was inaugurated by Dr. M.S. Randhawa, Vice-Chancellor, on 22nd and prizes were given by Ch. Balram Jakhar on 23.6.1976. The horticulture extension staff of the Punjab Agricultural University actively participated to make this show a success. This coordination of the Punjab Agricultural University in holding the grape show was very much appreciated by the grape growers of the State who participated in this function.

II- Gardeners Training Class Scheme :

The Gardeners Training Class functioned at Punjab Agricultural University, Ludhiana during the year under report as usual. 82 applications were received for 20 seats. Although the minimum prescribed qualification for admission to this course was middle pass, yet all the candidates selected were either matric or higher secondary pass. This shift is due to the reason that the diploma holders of Gardeners Training Class have started finding more employment opportunities in Government, Semi-government and private sectors on account of the interest of the government in improving the landscaping of the public sector. Out of twenty candidates 15 students attended the training throughout the year. One student who was injured in an accident is yet to take the final examination and five students left without completing the training due to their family circumstances. Out of 15 students 14 have taken the final examinatio

and were declared successful while one who injured in an accident is yet to take the final examination.

III- Holding of Demonstration & Classes in fruit & vegetable preservation :

The work on holding demonstration in fruit and vegetable preservation on home scale was carried out with a great enthusiasm all over the State. In all 60 demonstrations of 2-4 days duration and 8 short courses of about one week duration were organised throughout the State during the period under report.

In those demonstrations/courses 4,981 ladies and 1,364 gents were imparted training making the total number of beneficiaries as 6,345. The fruit preservation staff also participated in Kisan Mela, Kisan Diwas, exhibitions and shows. Detail of these demonstrations and classes is given in Table 96.

Fruit Preservation Service Centre : The Fruit Preservation Service Centre has been started in the hutments for the benefit of the public prior to the sanction of any staff for it. The work of the centre was carried out efficiently with the existing staff of the scheme "Holding of demonstrations and classes in fruit and vegetable preservation".

183 customers mostly housewives were attended to for getting their different fruit products prepared at the service centre during the period under report.

The centre is gaining popularity day by day and the number of the customers is increasing rapidly. In the absence of adequate staff the running of the preservation centre efficiently will be at the cost of the demonstration work of the scheme "Holding of Demonstrations & Classes in Fruit & Vegetable Preservation" to be carried out throughout the State for the benefit of the public.

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TABLE...96 : List of demonstrations and classes held at different places during the year 1975-76

Date	Name of centre	No. of persons attended		
		Ladies	Gents	Total
3.7.75	V. Saidowal Khurd, District Gurdaspur	23	-	23
3.7.75 - 5.7.75	Food Research Institute Sector-26, Chandigarh	60	-	60
6.7.75 to 8.7.75	D.A.V. College, Nakodar	250	300	550
14.7.75	C.D.T.C., Batala	12	10	22
12.8.75 - 13.8.75	Military Officers housewives in Sector-28, Chandigarh	15	10	25
12.8.75 - 13.8.75	Farm Women Camp at V. Majri organised by the Home Science College, Punjab Agricultural University, Ludhiana	25	-	25
19.8.75 - 20.8.75	V. Khushalpur, District Gurdaspur	19	-	19
20.8.75	Farm Women Camp at V. Jhorian near Raikot organised by the Extension Department, Punjab Agricultural University, Ludhiana	30	-	30
24.8.75	Fruit Preservation Show at V. Doda (Faridkot) organised by the Chief Agricultural Officer, Faridkot	250	200	450
28.9.75 - 30.9.75	D.A.V. College (Girls Wing), Nakodar	50	-	50
28.8.75	Lectures at Saroopwali (Gurdaspur)	26	-	26
25.10.75	Lectures at C.D.T.C., Batala	7	18	25
27.10.75 to 30.10.75	Community Development Trg. Centre, Batala	30	-	30
10.11.75 to 12.11.75	Farm Women Camp & Ladies Sewing Centre at V. Kohara (Ludhiana)	45	-	45
13.11.76 to 15.11.75	Housewives of Rural area at V. Dewatwal, Block Ludhiana	55	-	55
17.11.75 to 19.11.75	Fruit Preservation Training Course for Ladies at V. Mahalan (Nawanshahar)	25	-	25
25.11.75	Show at V. Sahabana organised by the Extension Department, Punjab Agricultural University, Ludhiana	5000	-	500

Contd...

26.11.75 - 28.11.75	Farm Women & other housewives Camp at V. Manakwal, Block Ludhiana	60	-	60
26.11.75 - 29.11.75	Govt. Hr. Sec. School, Garhshankar	-	55	55
2.12.75 - 5.12.75	Mahila Mandal & other housewives F.P. training course at V. Bulara Block : Ludhiana	65	-	65
9.12.75 - 12.12.75	Mahila Mandal Camp at V. Bhanobad District Ludhiana	55	-	55
15.12.75 - 19.12.75	Guru Gobind Singh College, Jandiala, District Jullundur	85	40	125
16.12.75 - 19.12.75	F.P. Training class for Ladies at V. Ghiaspura, Ludhiana Block	85	-	85
22.12.75 - 25.12.75	Farm Women Camp at V. Yali Kalan	75	-	75
23.12.75 - 24.12.75	Govt. Girls School, Yali Kalan (Ldh)	80	-	80
27.12.75	Ladies Sewing Centre, V. Alamgir	20	-	20
29.12.75 - 31.12.75	Farm Women Camp for F.P. Training course at V. Alamgir (Ludhiana)	45	-	45
12. 1.76 - 16. 1.76	Ladies Sewing & Craft Centre at V. Lalton Kalan (Ludhiana)	65	-	65
19. 1.76 - 24. 1.76	Farm Women & Ladies Sewing Centre V. Ghabaddi (Ludhiana)	75	-	75
21. 1.76 - 24. 1.76	Community Development Training Centre, Batala	32	-	32
27. 1.76 - 31. 1.76	Ladies Sewing Centre & other housewives of V. Khanpur (Ludhiana)	80	-	80
2. 2.76 - 6. 2.76	Farm Women Camps & Girls Sewing Centre, V. Bhutta (Ludhiana)	85	-	85
3. 2.76	Demonstration in fruit preservation at Model Town, Phagwara	25	-	25
9. 2.76 - 13. 2.76	D.A.V. College for Women, Lawrence Road, Amritsar	90	-	90
10. 2.76 - 11. 2.76	Fruit Preservation Training to ladies at V. Rampura, Nur Mahal Block	55	-	55
17. 2.76 - 19. 2.76	Fruit Preservation Class for Ladies at Ahmadgarh, Ward No. 8	65	-	65
17. 2.76 - 22. 2.76	Housewives of Military Officers, Cantonement Area, Amritsar	65	-	65
23. 2.76 - 24. 2.76	Housewives of Military Jawans, Amritsar Cantt.	250	-	250

25.2.76	Mess Cooks of Amritsar Cantt.	25	-	25
25.2.76 - 28.2.76	Fruit Prescrvation Class for Ladies at V. Mehroli near Nangal	45	-	45
26.2.76 - 28.2.76	F.P. Class for Ladies at Nangal Township (E.E.H. Block)	60	-	60
5.3.76	B.D.O. Office, Doraha	-	15	15
9.3.76 - 10.3.76	Lady Panches, Sarpanches, Gram Sevakas, Lady Sewing Teachers of Doraha Block	250	50	300
11.3.76 - 13.3.76	Rural Women Camp at V. Jaipura, Doraha Block	75	-	75
16.3.76 - 20.3.76	Ladies Sowing & Craft Centre & other Housewives of V. Maksudra (Ludhiana)	80	-	80
18.3.76	Fruit Prosorvation Class for Punjab Agricultural University Ladies Club	32	-	32
26.3.76 - 27.3.76	Kisan Mela, PAU Campus, Ludhiana	250	300	550
28.3.76	Ladies Sewing Centre & Housewives of V. Jaipura, Doraha Block	65	-	65
29.3.76 - 31.3.76	Farm Women Camp Ladies of Sewing Centre, V. Ghaloti, near Payal (Ludhiana)	75	-	75
2.4.76 - 4.4.76	All India Farmers' Sammelan at PAU Campus, Ludhiana	250	325	575
5.4.76 - 8.4.76	Housewives & girls of Sewing Centre at V. Ajnod, Doraha Block	75	-	75
14.4.76 - 17.4.76	Fruit Preservation Training Course to rural women of V. Ishanpur (Ludhiana)	70	-	70
16.4.76 - 18.4.76	Community Development Training Centre, Batala	50	-	50
20.4.76 - 24.4.76	Fruit Preservation Class to Ladies & Farm Women at V. Govindpura (Ludhiana)	60	-	60
2.6.76 - 11.6.76	Youth Leadership Training Camp for Girls, Dalhousie	50	-	50
18.6.76 - 20.6.76	Community Development Training Centre, Batala	32	-	32
21.6.76 - 26.6.76	Guru Nanak College for Girls, Model Town, Ludhiana	70	-	70
23.6.76 - 26.6.76	V. Kot Santokh Rai (Gurdaspur)	4	9	13

28.6.76 - 29.6.76	Training Camp for Ladies, V. Sardulgarh, Distt. Bhatinda	80	-	80

Short Courses of one week duration

10.11.75 - 15.11.75	Govt. Middle School, Dalian Ranjanpur (Gurdaspur)	18	9	27
19.11.75	R.R. Bawa College, Batala	39	-	39
16.12.75 - 22.12.75	S.N. College, Qadian	22	-	22
12. 1.76 - 18. 1.76	Adarsh College, Pathankot	-	12	12
5. 3.76 - 13. 3.76	Govt. Girls High School, Dinanagar	20	-	20
24. 3.76 - 31. 3.76	Engerton Mills, Dhariwal	14	-	14
14. 5.76 - 22. 5.76	Hindu Putri Kanya Pathshala, Dhariwal	23	-	23
4.6.76 - 11. 6.76	Gandhi Memorial School, Batala	21	-	21
	Grand Total :-	4,981	1,364	6,345

1- No. of classes held in the State : 8

2- No. of demonstrations held in the State : 60

3- No. of persons attended : 6345

Ladies : 4981 Gents : 1364

TECHNICAL SUMMARY

H-1.1 (A) i : Varietal trial on sweet orange for arid-irrigated regions of the Punjab

A varietal trial with six sweet orange cultivars, viz. Jaffa, Blood Red, Pineapple, Hamlin, Musambi and Valencia has been in progress at Abohar since September, 1961. Valencia and Jaffa maintained their superiority in tree vigour while Blood Red and Pineapple were the poorest in this regard.

Valencia yielded significantly lesser number of fruits than any other cultivar except Blood Red, which in turn bore significantly lesser than Jaffa only. Musambi, which gave maximum number in the previous year, was next to Jaffa. Juice percentage was maximum in Valencia fruits, whereas, Hamlin fruits had the least juice content. Peel percentage was the highest in Blood Red. The juice of Musambi contained maximum total soluble solids and minimum acidity. The highest acidity was found in Valencia fruits.

H-1.1 (B) i : Varietal trial on mandarin

Budded plants of nine cultivars, viz. Kinnow, Wilking, Dancy, Lahore Local, Srinagar, Nagpur, Feutral's Early, SZ-IN-CON and Unshiu were established in August, 1970. Performance of Kinnow, Wilking, Feutral's Early and SZ-IN-CON has been good. It is planned to lay out a regular varietal trial after raising plant material.

H-1.1 (BT) i : Collection of citrus germplasm

Some 90 citrus species/cultivars have already been planted - each represented by four plants. The initial girth measurements of these plants have been recorded. The seeds of 42 cultivars were sown in

the nursery in September,1975. Seeds of 29 cultivars have since germinated and the seedlings are likely to be transplanted in the field in March,1977.

H-1.2 (A) i : Rootstock trial on sweet orange

This experiment was started in 1968-69 with five sweet orange cultivars, viz, Blood Red, Musambi, Jaffa, Valencia and Pineapple budded on 8 to 4 rootstocks. The results during the year showed that Jatti Khatti excelled all other rootstocks in imparting vigour in all the scion cultivars. Blood Red/Cleopatra continued to give good performance. Blood Red and Jaffa on Kharna Khatta and Rangpur Lime rootstocks have shown acute bark cracking on stock portion and dwarfness respectively. On the other hand, Rangpur Lime has consistently given satisfactory performance with Musambi scion. The scion-stock ratio of Citrumelo rootstock with all the scions was the lowest. Blood Red, Jaffa, Musambi and Pineapple on Jatti Khatti gave the highest fruit yield, in contrast to other rootstocks.

H-1.2 (A) ii : Varietal-cum-rootstock trial with new promising citrus varieties

Field performance of four cultivars of citrus, viz. Wilking, Kinnow, Pearl and Campbell Valencia budded on four rootstocks, i.e. Jatti Khatti, Kharna Khatta, Troyer and Carrizo has been studied since September, 1968. As in the previous years, this year too Campbell Valencia and Pearl, though on a par with one another, were more vigorous in growth than Kinnow and Wilking trees. Maximum number of fruits (335.5) were borne on Kinnow/Kharna Khatta trees. The nutritional status of the leaves, both for macro and micro-nutrients, was also studied and zinc was found in the deficient range.

H-1.3 (A) : Effect of graded doses of nitrogen on the growth yield and quality of sweet orange - cv. Blood Red

The experiment was initiated on 4½-year-old Blood Red sweet orange trees in 1967. Control (no fertilizer) trees were compared with those receiving 28 g, 56 g, 84 g, 112 g and 140 g of Nitrogen per year age of the trees. The doses were made constant at the 8th year of age of the trees.

Although the trial has run for about 9 years, the treatments have failed to show any consistent indications of their effects on tree vigour, yield and quality of fruit. However, the trees under control (no nitrogen) were slightly less vigorous.

1.2 (GN) i : Rootstock trial on mandarins

The performance of Kinnow, Dancy and Desi Sangtra on Jatti Khatti, Kharna Khatta, Troyer, Cleopatra and Rubixoux rootstocks is to be tested to find out the best rootstock(s) for these cultivars. The experiment is being laid out in a split-plot design with the scions in the main plots and the rootstocks in the sub-plots. The plant material was being raised for this trial.

H-1.2 (L) i : Rootstock trial on sweet orange

The performance of Blood Red sweet orange was being evaluated on nine different rootstocks, in a field trial planted in 1969. The maximum tree height (3.41 m) was observed on Jatti Khatti and Nucellar Blood Red (3.26 m). The stock and scion girth was significantly affected in group A. However, in group B rootstocks, the maximum stock girth (45.97 cm) and scion girth (33.76 cm) was observed in Blood Red/Citrumelo combination. The minimum scion girth in group A (22.36 cm) was on Carrizo and (10.89 cm) in group B on Rangpur Lime.

H-1.3 (A) ii : Varietal-cum-fertilizer trial on grape-fruit

This trial has been in progress since September,1968 with Marsh Seedless, Duncan and Foster cultivars in the main plots and fertilizer doses, (viz. 30, 60 and 90 g of nitrogen per year age of the tree) in the sub-plots. The fertilizer doses were made constant after 5 years of age of the trees.

The differential N applications failed to affect growth significantly, though the trees receiving fertilizer were slightly more vigorous. Similarly, the difference in growth among the three cultivars was also non-significant. The trees receiving no fertilizer bore significantly less fruits than those under 60 g or 90 g treatments.

H-1.3 (A) iii : Nutritional trial on Kinnow mandarin

This trial has been in progress since January,1973 in order to find out the optimum dose(s) of N & P for Kinnow budded on Jatti Khatti. The treatments comprise of 12 combinations of N and P whereas K and FYM were also applied at the same level. The data recorded during the year, showed that growth and vigour of the plants have not been affected by any of the treatments significantly. Leaf-samples for analyses were collected in September, 1975 and the analyses for macro and micro-elements was under way.

H-1.3 (BT) iii : Studies on the relationship of lime concretion and $CaCo_3$ contents in the soil with tree vigour and macro-nutrient status in the leaves of sweet orange

In order to study the role of soil-borne factors in citrus decline, 210 soil samples collected from 30 profile bores around the trees representing healthy, fair and poor growth were analysed for some of their physical and chemical properties. The results obtained show that presence of lime concretion layers in the sub-soil and free calcium

carbonate were important factors responsible for poor growth of citrus. Fairly wide range of soil pH was found suggesting that soil pH was not a controlling factor of citrus decline. Probably, the relative importance of soil pH is conditioned by other soil properties and management practices. Salt concentration in all the profiles was found fairly low and below the limit considered unsafe for the growth of citrus.

H-1.3 (L) i : Effect of graded doses of nitrogen on the growth and quality of Musambi cv. of sweet orange (C. sinensis)

To study the effect of graded doses of N (0, 0.75, 1.00, 1.25 and 1.50 kg) on the different characters of Musambi Oranges a trial was initiated during the year 1970. The yield, fruit quality and tree growth did not increase significantly under any of the treatments applied. Highest yield by weight (19.60 kg) and number (131 fruits) was obtained under 1.25 kg N treatment. Under all the treatments, the values of leaf N were in the satisfactory range (2.44 - 2.71 %). The growth of trunk of the trees receiving N was slightly higher than those of the trees receiving no nitrogen.

H-1.3 (L) ii : Fertilizer trial on new citrus hybrids

A fertilizer trial with new citrus hybrids, viz. Kinnow, Wilking and Campbell Valencia sweet orange has been in progress since 1968. Maximum average diameter of Kinnow was observed in treatment $N_{150}\ P_{200} K_{0}$. Highest yield by number of fruits was obtained from the trees which received $N_{150} P_{150} K_{200}$ treatment combinations. T S S content was the highest (9.8%) recorded under $N_{150}\ P_{0}\ K_{50}$ treatment. Treatment combination $N_{2}\ P_{0}\ K_{1}$ recorded maximum number of fruits per tree in Wilking. The highest T S S was obtained in the treatment combination $N_{1}\ P_{2}\ K_{0}$. $N_{2}\ P_{2}\ K_{0}$ gave maximum number of fruits per tree in Campbell Valencia. Maximum T S S (8.86%) was obtained under $N_{1}\ P_{1}\ K_{1}$ treatment.

H-1.3 (L) iv : Survey to judge the mineral nutrition status of citrus orchard in the Punjab

A survey of prominent citrus orchards of Abohar area was carried out in order to judge their nutritional status in respect of N, P, K and S. In all, seven orchards were surveyed and 14 leaf samples of different sweet orange cultivars were collected. The nitrogen, potassium and sulphur were found to be in a satisfactory range in all the samples but phosphorus was found to be on the border line in some of the samples. It was observed that growth, yield and quality of the fruit was better where phosphorus was also applied to the trees.

The growth and yield of trees in the orchards receiving good care and nutrition was good. On the other hand, the growth and yield were poor in the neglected orchards and trees were showing the decline.

New Project : Effect of graded doses of N, P and K on the growth yield and quality of Sweet orange - cv. Jaffa

To find out economic dose of N P K for mature sweet orange trees of Jaffa variety this trial was started in January, 1975. Different treatments did not give significant differences for trunk girth, tree height and spread, av. fruit weight and acidity except T S S. The highest T S S (7-9%) was recorded under $N_2 P_0 K_1$ and $N_1 P_2 K_2$ treatments and lowest (6.7%) under $N_3 P_1 K_0$ and $N_2 P_2 K_2$ treatments.

New Project : Effect of N P and K on growth, cropping and quality of sweet orange - cv. Valencia

The trial was initiated during the year 1975, to find out the optimum doses of N, P and K. Three levels each of nitrogen, phosphorus and Potash (250, 500 and 750 g N; 0, 250 and 500 g $P_2 O_5$ and 0, 250 and 500 g $K_2 O$) per tree are being tried. There was significant increase in the yield, fruit size and T S S values, whereas the juice and peel weight

and tree diameter did not show significant difference. Treatment $N_2 P_3 K_2$ gave the highest yield (174.3 fruits). The highest T S S values (11.6%) was obtained under $N_3 P_3 K_3$ treatment.

H-1.6 (BT) ii : Studies on the control of weeds species in Musambi with Gesatop and Caragard herbicides

The trial was initiated during December, 1974 to study the effect of two herbicides viz. Gesatop and Caragard in three concentrations, i.e. 3 kg, 4 kg and 5 kg a.i./ha on the control of weed species in Musambi cultivar of sweet orange. All the herbicidal treatments proved ineffective in controlling the monocot weeds such as Baru (Sorghum halepense) and Khabbal (Cynodon dactylon) whereas their dry matter was significantly reduced. Dicot weeds namely Jangali Palak (Rumex acutus), Pili senji (Meliolotus indica), Krishan neel (Anagallis arvensis), Bathu (Chenopodium album) and Maina (Medicago denticulata) were completely checked by all the treatments. Dry matter of dicot weeds was also reduced significantly by these treatments.

H-1.8 (L) i : Studies on storage life of Kinnow

The Kinnow fruits harvested on 19.1.76, 3.2.76, 18.2.76 and 5.3.76 were held in cold storage at temperature of 0 - 3.3°C and relative humidity 85-90% after treatment with wax (6%) and 2,4,5-T (100 & 200 ppm) in polythene bags. The fruits harvested on first 3 dates were stored for 100 days and those harvested on 5.3.76 for 90 days. The physical appearance of fruits harvested on 18.2.76 was better during cold storage upto the end of storage life than that of the fruits harvested on other dates. The fruits in polythene bags experienced markedly less loss in weight than the control.

H-1.10 (L) i : Evaluation of nucellar trees of sweet orange in the field

Nucellar seedlings of five commercial cultivars of sweet orange namely Blood Red, Musambi, Jaffa, Valencia and Pineapple planted in the field were given all the recommended cultural and plants protection measures. Three representative plants from each cultivar were indexed chromatographically for the detection of greening infection. None of the trees was found greening positive. Observations on fruit quality and precocity were being recorded.

H-1.10 (L) ii : Incidence and rate of spread of citrus decline

The plant material comprising Nucellar Blood Red and Nucellar Musambi raised on Rough Lemon rootstock was ready for planting in the field to study the incidence and rate of spread of citrus decline.

H-1.10 (L) iii : Indexing of citrus viruses

(a) Two new viruses namely 'leaf curl' and 'satsuma dwarf', were suscepted as a result of surveys carried out in the State. Suscepted trees were indexed on both citrus indicators and herbaceous hosts and symptoms were yet awaited.

(b) Trees of 43 species/cultivars of citrus growing in the citrus collection block of R F R S, Abohar were screened for the presence of greening marker substance with a view to find out the incidence of greening infection. The results indicate that almost all the species/ cultivars of citrus tested, were infected with greening, except Florda Rough Lemon, Amilbed, Gajanimma and Kharna Khatta which were free from the marker substance.

(c) Blood Red sweet orange trees budded on different rootstocks viz. Jatti Khatti, Kharna Khatta, Troyer, Carrizo, Cleopatra, Citrumelo and Pectinifera are growing in the field since 1969 were also indexed

for greening marker substance. None of the combinations was found greening free. However, the minimum incidence of 25 per cent was recorded in Nucellar Blood Red trees raised on their own roots.

H-1.10 (L) iv : Certification, inspection and registration of virus-free citrus trees

More citrus orchards were surveyed around Abohar, Ludhiana and Attari and 27 candidate trees were selected and chemically indexed for greening mycoplasma. Results revealed that one Baramasi Nimbu (Acc 396) and 3 trees of Musambi (Acc Nos. 399, 400, 402) were free from greening. The remaining trees turned out to be greening positive. Greening-free trees were further indexed for Tristeza, Exocortis and Psorosis viruses.

A total of 980 virus-free buds of different citrus species/ cultivars were supplied to various research stations of Punjab Agricultural University and the country.

Propagative material, both seeds and bud-wood of Swingle citrumelo was imported from California, USA. This rootstock is reported to be resistant to most of the components of citrus die-back complex and was being propagated inside the screen house at Ludhiana.

H-1.10 (L) v : Studies on styler-end and stalk-end rot of citrus fruits

To study the effect of Alternaria citri and Colletotrichun gloeosporioides - the causal organisms of styler-end and stalk-end rot of sweet orange - fruits of Blood Red and Pineapple were inoculated. Results revealed that both pathogens reduced the level of sucrose, glucose and amino acids in general, except in case of Alternaria infected fruits in which cystiene and cystine, glutamic acid, L-alanine + Valine and methionine increased. The level of arginine remained unchanged and a-Butyric-acid accumulated in Alternaria rotton fruits.

H-1.10 (L) vi : Studies on the relationship between greening disease of citrus and its vector

The density population of citrus psylla and the prevalence of the greening disease was recorded on different citrus species/cultivars planted at R F R S, Abohar. Results revealed that there was a positive correlation between the vector population and the incidence of the disease.

H-1.10 (L) vii : Studies on the seasonal occurrence and population density of citrus psylla (Diaphorina citri) and its control

Psylla population recorded at different places viz. Ludhiana, Abohar/Jagraon and Hoshiarpur revealed that the population was markedly low at Hoshiarpur.

H-1.12 (A) : Studies on granulation in citrus.

To ascertain the extent of granulation in citrus, a comprehensive survey of the citrus orchards was undertaken in which the fruits were collected one month before the ripening period, at maturity and one month after the ripening period in a number of citrus cultivars/species available at R F R S, Abohar. The data revealed that the extent of granulation increased with approaching of harvest time in citrus fruits. Sweet orange (cv. Jaffa) had maximum incidence of granulation. Further the intensity of decline increased the incidence of granulation. Jatti Khatti produced maximum granulated fruits in the scion cultivars budded on it whereas Cleopatra, Pectinifera and Citrumelo tended to reduce the incidence of granulation. Among sweet orange cultivars, Valencia was least affected by different rootstocks in terms of granulation.

H-2.1 (A) i : Varietal trial on grapes to find out varieties for arid-irrigated regions of Punjab

This trial is in progress at Abohar since 1966 with a view to

select promising cultivars for commercial cultivation in the arid-irrigated regions. Beauty Seedless, Perlette, Delight and Early Muscat were the earliest to sprout (March 3-5) whereas Anab-e-Shahi and Selection-7 sprouted last of all (March 11-15). In trunk girth, Anab-e-Shahi maintained its lead (34.9 cm) like previous years over other cultivars. Maximum yield (18.515 kg per vine) was produced in Beauty Seedless and minimum in Anab-e-Shahi, Bedana and Pusa Seedless. Beauty Seedless, Early Muscat and Perlette were the earliest to ripen whereas, Anab-e-Shahi and Selection-7 ripened last of all. Perlette clusters were the heaviest in weight (525 g). TSS/Acid ratio was maximum (30.39) in Gold.

H-2.3 (L) ii : <u>A survey to judge the mineral nutrition status of vineyards in Punjab</u>

A survey to judge the mineral nutrition status of vineyards (initiated in 1971) in Punjab was continued further. The leaf samples were collected from major vineyards of each district of the State from three cultivars, i.e. Perlette, Anab-e-Shahi and Thompson Seedless. These samples were analysed for their N, P and K content. The yield of the vineyards was also estimated at the time of collecting the leaf samples and was categorised as high, average and low.

It was noticed that the nitrogen range was not much different as compared with standard values but the P and K were on the higher side. The nitrogen and phosphorus contents were found low in vineyards of high productivity. The potassium, however, was on higher side in all the vineyards but values were comparatively less in vineyards having high yields. The survey, thus, indicated that our vineyards were being supplied with high doses of fertilizers particularly those of P and K.

H-2.6 (L) i : Chemical Weed Control in grapes

Six pre-emergence type of weedicides, viz. Diuron, Gesatop (Simazine), Gesaprim (Atrazine), Tafazine, Dasalin and Tok E-25 were tried in the P A U vineyard at Ludhiana. The results showed that all the weedicides were effective in controlling both the monocot as well as dicot type of weeds. Out of these weedicides, Diuron was found to give excellent control of the weeds. It is, therefore, recommended that Diuron at the rate of 3.0 to 3.5 kg/ha may be used in the grown up vineyards.

H-2.7 (L) i : Hybridization studies to evolve early ripening and seedless varieties of grapes

Out of 1958 hybrid seedlings which survived as a result of field plantation, as many as 170 were evaluated during 1976 fruiting season for their early ripening, high T S S and seedlessness characteristics. These hybrids were from the crosses of Banquabad x Himrod, Banquabad x Perlette, Banquabad x Thompson Seedless, Karachi Gulabi x Himrod, Karachi Gulabi x Thompson Seedless, Karachi Gulabi x Perlette and Early Muscat x Perlette. The highest percentage of hybrids which came into bearing were from Banquabad x Himrod cross, followed by Banquabad x Perlette. One hybrid from Banquabad x Perlette was found to be the earliest in ripening (30.5.1976) when it had a T S S of 20 per cent. In general, the ripening was earlier in Banquabad x Himrod crosses as compared to Banquabad x Perlette. Also majority of the hybrids produced berries with medium T S S. However, more than a dozen promising hybrids have been found, both in respect of their earliness and high T S S ranging from 20-26 per cent. Out of 170 hybrids screened, nine were found to be soft-seeded and six practically seedless.

H-2.8 (L) i : Studies on cold storage of grapes

Anab-e-Shahi grapes were cold stored at a temperature of 0 - 3.3°C and relative humidity of 85 - 90 per cent in polythene wrappers of varying thickness (100, 200 and 300 gauge) and directly in wooden boxes. The fruit samples were taken out of cold storage after 20, 40, 50 and 60 days. The loss in weight was the least in polythene wraps and was much more in control treatment. The berry shatter was not affected by any treatment whereas berry rot increased with the thickness of polythene gauge. The chemical composition of grapes under various treatments did not differ much.

New Project : Studies on histology of coulure

Histological studies concerning drop of flower buds, flowers and unfertilized small berries (coulure) were conducted. The drop was found to result from formation of an abscission layer in the pedicel. The ovules of dropped buds and flowers were normal. The pollens showed fair percentage of viability with acetocarmine test but did not germinate in sugar solution (15 to 25%) and room temperature of five degrees below room temperature.

H-3.2 (G) i : Rootstock trial on mango

During the year, 17 seedlings of Kurukkan and 4 seedlings of Olour cultivar were transplanted and subsequently headed back to a stump 3" above the ground level. These stumps have produced 6-8 lateral shoots which will be layered in July,1976 to get uniform clonal rootstock.

As a part of this trial, fourteen plants each of the seedling - Totapari Red Small - Dusehri and Seedling - Krishan Bhog - Dusehri combinations have been propagated and its performance will be observed in due course, in comparison to plants of seedling - Dusehri combination.

H-3.3 (G) i : Fertilizer trial on mango

This trial was initiated during 1968 at the Fruit Research Station, Gurdaspur in order to find out the optimum fertilizer dose. Data on trunk girth, height and volume of the trees show that only N_3P combination having 300 gm N and 50 gm P_2O_5 per year age of the tree was significantly better than all treatment combinations in producing more girth. Data on tree height and volume were, however, non-significant.

H-3.3 (GN) i : Fertilizer trial on Mango

In this experiment, 27 factorial combinations of N, P and K shall be tested to find out the best for growth and fruiting of Dusehri in the submontaneous tract of this State. The plant material for this experiment is being established in the field.

H-3.3 (L) i : Effect of N P and K on growth, cropping and quality of mango - cv. Dusehri

To find out the optimum doses of N, P and K the fertilizer trial was initiated during the year 1971. Three levels of nitrogen (100, 200 and 300 g) two levels each of phosphorus and potash (100, 200 g) per tree are being tried. There was no significant difference in the yield, fruit size and quality under any of the treatments applied. However, highest fruit yield (71.04 kg) and tree diameter (19.30 cm) were recorded from the trees which were supplied with low level of N, P and K (100, 100, 100 g) combination. Pulp weight (181.00 g) increased with the fruit size (214.00 g) under T_7 treatment.

New Project : Nutritional Status of mango trees in relation to biennial bearing

This project has been initiated this year in order to see the relationship between biennial bearing and nutrient status of mango trees.

Leaf samples were collected from ten trees each of Dusehri and Langra cultivars twice, i.e. October, 1975 and April,1976. These samples have since been analysed for N, P and K content. The leaf analysis data indicated that there was no difference in P and K contents of the two cultivars in both the timings of sampling. However, N content appeared slightly lower in Langra mango leaves.

New Project : Survey to judge the mineral nutrition status of mango orchards in the Punjab

A comprehensive survey of mango orchards of Gurdaspur district was carried out, to assess their nutritional status. In all, 22 orchards were surveyed and forty three leaf samples from different cultivars, i.e. Dusehri, Langra, Fazri, Chausa and Bombay Green were collected. Soil samples were also taken from these orchards. The leaf samples have been analysed for their N, P and K content and are being processed for other macro-and micro-elements.

The leaf analyses data indicated that in almost all the samples of different cultivars the leaf N, P and K content was above the standard optimum level. It is interesting to mention that out of twenty two orchards surveyed, six were never given any manure or fertilizer, seven were supplied with little quantity of farmyard manure only, five were given nitrogen only and only four orchards were supplied with N, P and K fertilizer. Both growth and yield were very poor in orchards which were neglected and were not being given any fertilizer.

H-4.1 (B) i : Varietal-cum-fertilizer trial on Plum

The results obtained during the year showed significant differences for trunk girth, height and spread of trees of different cultivars whereas the four nitrogen levels did not cause any significant differences in these respects. The highest trunk girth, tree height and

spread were observed in Alubukhara Sharbati and the lowest in Ladakh.

Significant differences were also observed in respect of fruit yield, T S S and acidity under different cultivars. Highest yield (65.16 kg per tree) was found in Zardalu and lowest yield (31.83 kg per tree) in Alubukhara Sharbati. The four N levels showed significant differences for fruit yield only as no significant differences were observed in T S S and acidity.

H-4.1 (BT) i : Varietal collection and evaluation of plum

With a view to screen out the suitable cultivar(s) of plum for commercial cultivation, a trial was initiated at the Fruit Research Station, Bhatinda in January,1974. Twenty-five cultivars have since been collected. Out of the twenty varieties planted in 1974, Alucha Red was observed to be vigorous, based on girth (20.90 cm) as well as canopy size (1.56 m^3) of the tree whereas Alucha Large Yellow was slow in growth, their girth and canopy size being 3.83 cm and 0.03 m^3 respectively. Black Early was the earliest to flower (February 19) and to sprout (February 18) whereas Kelsey Japan sprouted last of all (March 9).

H-4.1 (BT) ii : Varietal trial on plum

This trial with six cultivars namely Alubukhara, Ladakh, Titron, Zardalu, Kataroochak and Lalri was started in January,1974. Cv. Ladakh was most vigorous with the highest girth (21.12 cm) and canopy size (1.95 m^3). Kataroochak, on the other hand, was observed to be slow in growth. Titron and Kataroochak were the earliest to flower (February 11) and Alubukhara was the last (February 29). Titron set fruits first of all on February 21.

H-4.3 (L) i : Manurial trial on plum (Cv. Titron)

In a manurial trial on plum, the trunk diameter and plant spread were significantly affected by the N P K treatments. The trunk diameter (8.03 cm), height (2.86 cm) and spread (2.45 m) was the greatest under N_3 P_1 K_1 treatment. The fruit quality was better with lower N doses combinations with P and K.

H-4.7 (L) i : To find out suitable varieties of plum for commercial cultivation in the Punjab

Twenty four varieties came into flowering during 1976. Cv. Titron was the earliest to bloom under local conditions. The variety Kataroochak ripens in Ist week of May which is followed in succession by Kala Selection 2 and 3, Alubukhara, Yellow Gurdaspur, Golden Lalri and Ladakh. The Alubukhara fruit was the heaveist in weight (20.5 g). The highest yield was recorded in Kala Selection 2 (20.5 kg) and the lowest in Alucha (4.0 kg).

H-5.1 (BT) i : Varietal collection and evaluation of peach

Peach collection work was initiated during January, 1974. So far, some 35 cultivars have been collected. Maximum girth (24.4 cm) was recorded in Jewel whereas it was minimum (8.63 cm) in Peach Dwarf. However, canopy size was observed maximum (3.85 m^3) in Surkha and minimum (0.11 m^3) in Dwarf peaches, i.e. June Gold and Peach Dwarf. Except Alexander and Perigreen, all cultivars flowered this year.

H-5.1 (BT) ii : Varietal trial on peach

Performance of six cultivars, viz. Matchless, Peshawari Gold, Sunred, Sufeda, Sharbati and Flordasun is being studied. It was observed that the girth and canopy size of the trees of all the six cultivars were statistically on a par. Peshawari Gola was the earliest to flower

(January 19) and set fruits while Flordasun was last to flower (February 7). Matchless was the earliest to sprout (January 21) and Sunred sprouted last of all, viz. on February 5.

H-5.3 (L) i : Effect of N, P and K on the growth, yield and quality of Sharbati cv. of peach (Prunus persica B)

To find out the optimum dose of N, P and K on the growth and fruit quality of peach, this trial was initiated in 1972. Differential doses were given in 1975. Fruit yield (30.7 kg) was significantly more under N_2 P_1 K_2 treatment than the other treatments applied. Treatment N_3 P_1 K_2 gave the highest fruit weight (61.2 g), size (5.27 x 4.71 cm), pulp/stone ratio (9.7), and acidity (0.35%). However, this increase did not differ significantly. Highest T S S (17.2 %) was recorded under N_2 P_1 K_2 treatment. There was no significant difference in the nutrient status in the leaves.

H-5.7 (L) i : To find out the varieties of peach suitable for commercial cultivation in Punjab

Studies on performance :

Among all the peach cultivars studied Ranjit Bagh Early ripened earliest of all, i.e. by the middle of May. The cultivar Sufeda outyielded others with 30.48 kg/tree average yield, followed by Jewel.

Hybridization Work :

As a result of hybridization attempted during 1974-75 about 80 plants could be raised and planted in the field in February, 1976. During spring 1976 season, 5 crosses were attempted employing about 2,500 flowers. About 400 hybrid seeds have been obtained, which have since been stratified.

H-6.2 (GN) i : Rootstock trial on pear

The object of this experiment is to study the performance of

Patharnakh and Baghugosha on four different rootstocks, viz. Pyrus pyrifolia, Pyrus pashia, Cydonia oblonga, D - 4 (A type of Kainth) and also to test the performance of grafted plants in comparison to those raised from cuttings in a split-plot design. The plant material for this trial was planted in the field in January,1976.

H-6.2 (L) i : Rootstock trial on pear

Cvs. Leconte, Kieffer and Smith appeared more vigorous on Kainth than on Patharnakh. Baghugosha on both the rootstocks showed a little difference. The lowest vigour was observed in Kieffer/Patharnakh. Kainth had the maximum stock girth with all the four cultivars than Patharnakh. Leconte and Kieffer scion girth was the highest on Kainth and the lowest on Patharnakh.

H-6.3 (B) i : Varietal-cum-fertilizer trial on pear

Trunk girth and tree height were significantly higher in Patharnakh and lowest in Smith and Leconte respectively. Different N levels did not show significant response for these characters. Highest yield (60.21 kg) per tree was obtained in Smith, followed by Leconte (44.55 kg) and lowest in Patharnakh (24.64 kg). The highest fruit yield by number (421) was obtained under T_4 (100 g N) and the lowest fruit number (328) under T_4 (25 g N).

H-6.3 (L) i : Effect of graded doses of NPK on the vigour cropping and fruit quality of pear (Patharnakh)

This project was initiated during February,1972 to find out the optimum dose of NPK for Patharnakh Pear. The growth of the pear plants was not affected significantly by any of the NPK treatments. However, the greatest trunk diameter (12.90 cm) and plant height (6.03 m) were obtained under N_2 P_1 K_1 treatment.

H-6.8 (L) i : Studies on cold storage life of Patharnakh pear

Patharnakh pear fruits were cold stored at a temperature of 0 - 3.3°C and relative humidity of 85 - 90 per cent. The fruits were packed in polythene wrappers (200 gange) as well as in wooden crates with and without treatment of Captan (0.2 %). One lot of fruits was placed in cold storage immediately after harvest while the other lot after 10 days of storage at room temperature. Among all the treatments, the fruits which were wrapped in polythene after Captan treatment experienced the least loss in weight and spoilage. The chemical composition of fruits under various treatments did not differ much.

H-8.2 (G) : Fruit drop studies in litchi

The trial remained in progress from 1968 to 1975 at the Fruit Research Station, Gurdaspur. Three growth regulators viz. NAA, 2, 4-D and 2, 4, 5-T were tried each at a concentration of 20, 40 and 60 ppm during 1968 ; 5, 10 and 15 ppm during 1969 and 1971; and 2, 3 and 4 ppm during 1972, 1973 and 1975. Results showed that the chemicals did not reduce the fruit drop.

H-8.3 (G) i : Fertilizer trial on litchi

In this trial, three levels of nitrogen (50, 75 and 100 gm per year age) and two levels each P_2O_5 and K_2O (25 and 50 gm per year age) are being tried. Replication-wise data have been recorded and will be compared when the plants in the 3rd replication attain the age of six years.

H-8.3 (GM) i : Varietal-cum-fertilizer trial on litchi

This experiment aims at to test three levels of nitrogen in combination with two levels each of phosphorus and potash in order to

find out the best combination of NPK for the optimum growth and fruiting of three litchi cultivars, viz. Calcutta Late, Seedless Late and Dehra Dun. The experiment material for this trial was being established in the field.

H-8.12 (G) ii : Bearing in relation to growth in litchi

The data showed that in cultivars Calcutta Late and Seedless Late - the branches which did not produce fruit last year - did not even flower this year and continued vegetative growth. Cultivar Dehradun also did not maintain its previous trend of bearing every year and the bearing branches produced very little fruit during 1976.

Seed stones of the third proposed variety are being arranged from Kerala. The trial is very likely to be planted in 1977. As a part of this trial plants of seedlings - Totapari - Dusehri and Seedling - Krishan Bhog - Dusehri combination are ready and its performance will be recorded in the coming year.

H-8.12 (G) iii : Studies on the establishment of litchi

This trial was initiated at the Fruit Research Station, Gurdaspur during 1972 to ascertain the right age of Litchi plant for transplantation. One and two year old plants have already been compared. Plants of three year age are ready and shall be transplanted during September, 1976 and compared for their success with one-and two-year old plants.

H-9.8 (A) i : Curing of dates - loss of sugars during boiling

Doka fruit of Hillawi, Medjool, Shamran and Khadrawi was boiled for 2, 4, 6, 8, 10, 14 and 18 minutes and loss of sugars by way of leaching in boiling water was determined. Loss of sugars in water was directly proportional to time of boiling. Medjool lost maximum sugars (19.7%) and Khadrawi the minimum (7.8%).

H-9.9 (A) i : Thinning of date-palm

Thinning of Khadrawi by levelling of inflorescence at 5 cm from the tip, removal of one-third inflorescence from terminal of the inflorescence of the spadix in addition to levelling and removal of one-third berries after fruit-set was compared with no thinning. The thinning treatments reduced the yield and did not advance maturity.

New Project (A) : Rooting of aerial suckers in datepalm

To make use of aerial offshoots, a trial was initiated in October, 1975 to induce rooting. Basal portion of the offshoots attached to mother palms was covered with wet wooden shavings or moss grass saturated with water enclosed in polyethylene. This was compared with direct planting without rooting (control) and planting after treatment of the basal portion with 1000 ppm or 3000 ppm of IBA. All the offshoots planted after detachment from the mother palms, whether treated or not, died without striking roots in 4-5 months. Offshoots covered with moss grass initiated roots after about 3 months whereas, this period in case of treatment with wooden shavings was 5 months.

H-10.3 (B) i : Effect of graded doses of N P K on the vigour, cropping and quality of guava

This trial was started in August, 1970 to study the effect of N, P and K fertilizer on the performance of guava - cv. Allahabad Safeda. Trunk girth and tree spread differences were significant. Trunk girth was the highest under N_1 P_1 K_2 and N_3 P_1 K_2 and tree spread was highest under N_3 P_3 K_3. The fertilizer treatments failed to bring significant differences with respect to tree height, fruit yield, T S S and acidity.

H-10.7 (L) i : Improvement of guava through selection

A large number of open-pollinated guava seedlings of variety Safeda, Sardar Guava and Seedless growing in the College Orchard were being screened. 900 seedlings came into flowering in April, 1976. Their fruit quality will be evaluated in due course.

H-11.2 (L) i : Rootstock trial on Ber

A ber rootstock trial with Umran budded on 14 rootstocks has been under way. The growth data recorded showed that plants on Z. mauritiana (Elongated from Dehradun) were having the maximum stock (66.41 cm) and scion girth (62.06 cm) whereas the plant spread were the maximum in case of plants propagated on Z. mauritiana (Globular Dehradun). The plants on Z. mauritiana (Coimbatore) were having smooth union, though were less vigorous.

H-11.9 (L) i : Spacing-cum-pruning trial on Ber

In a spacing-cum-pruning trial on Umran cultivar of Ber, the height of the plants was significantly affected by different spacings. The plants were taller in 15' x 15' than in 30' x 30'. The trunk girth was significantly affected by spacing as well as pruning treatments. The unpruned trees in all the spacings were having more girth and spread.

H-12.1 (L) : Varietal collection and evaluation of pomegranate

Almost all the varieties came into flowering and fruiting. The flowering was completed by 3rd week of April. The total number of fruits produced by different varieties alongwith the extent of crackness was recorded. Cv. Anar Malas had the highest number of fruits (28.5 per plant) with a low incidence of cracked fruits. The incidence of cracking

was very high in cultivars Suni Bedana, Seedless, Chola Selection 71 and Dholka. None of the cultivars, was found completely free from the cracking trouble.

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NONTECHNICAL - SUMMARY

C I T R U S

A varietal trial on six commercial sweet orange cultivars (in progress at the Regional Fruit Research Station, Abohar since September,1961) revealed that Valencia and Jaffa were the most vigorous, Pineapple and Blood Red the poorest, whereas Musambi and Hamlin were intermediate in vigour as shown by the trunk girth, height and spread of the trees. During the year, Jaffa and Musambi gave the best performance in respect of fruit yield, while Valencia bore minimum number of fruits. Juice percentage was maximum in Valencia and minimum in Hamlin.

An observational trial to compare performance of nine different cultivars of mandarins, tangarines and tangelos has remained in progress at Bahadurgarh (Patiala) since 1970. Kinnow, Wilking, Feutral's Early and SZ-IN-CON are showing good performance. It is planned to plant a regular trial after propagating uniform material.

A comprehensive citrus collection is being established at the Fruit Research Station, Bhatinda and some 90 citrus species/cultivars have already been planted in the field. The seedlings of another 29 cultivars/species were being raised in the nursery and will be planted in the field in 1977.

A rootstock trial was laid out in 1968-69 at the Regional Fruit Research Station, Abohar, with five sweet orange cultivars budded on 8 to 4 rootstocks. Trees budded on Jatti Khatti were more vigorous in case of all the scion cultivars. Blood Red/Cleopatra trees continued to give satisfactory performance. Blood Red and Jaffa budded on Rangpur Lime and Kharna Khatta have developed acute bark cracking on the stock portions. Citranges as rootstock have shown poor

vigour. In case of Musambi, these have proved an utter failure. The stock portion in Citrumelo has shown overgrowth in all the scion cultivars. During the year all the cultivars except Valencia yielded the highest number of fruits on Jatti Khatti rootstock.

Field performance of four new promising cultivars, viz. Wilking, Kinnow, Pearl and Campbell Valencia on four rootstocks - Jatti Khatti, Kharna Khatta, Troyer and Carrizo was being studied at Abohar since September, 1968. Campbell Valencia and Pearl maintained lead in growth and vigour. Among the scion cultivars, Kinnow gave better yield on Kharna Khatta stock.

In a rootstock trial at Ludhiana, the growth of Blood Red trees was the best on Jatti Khatti rootstock. Nucellar plants and plants on Cleopatra gave the best growth in the plantation made in July, 1969. On Rangpur Lime, the growth was the poorest.

A nutritional trial has been in progress at Abohar since 1967 to find out optimum nitrogen requirements of Blood Red sweet orange. Six differential nitrogen treatments were compared with no nitrogen. Although the trial has run for about 9 years, the nitrogen treatments failed to show any significant differential effect on tree vigour, yield and fruit quality.

A varietal-cum-fertilizer trial on Marsh, Duncan and Foster was laid out at Abohar in September, 1968 with nitrogen applications of 30, 60 and 90 g of nitrogen/tree/year. The fertilizer failed to affect the growth though the trees receiving no nitrogen were slightly less vigorous. However, control trees yielded less fruit than those receiving N doses. The juice of Foster was most acidic and this cultivar also showed the poorest vigour.

A nutritional trial on Kinnow mandarin was laid out at RFRS, Abohar in January, 1973 with four doses (25, 50, 100, 150 gm) of nitrogen

and three doses (0, 50, 100 gm) of phosphorus, were applied in February and June,1976. Potassium and farm-yard-manure were applied at the same level to the plants. The different treatments have so far failed to affect growth and vigour significantly.

In order to study the role of soil-borne factors in citrus decline, 210 soil samples were collected at Fruit Research Station, Bhatinda from 30 profiles around sweet orange trees representing healthy, fair and poor growth. The results obtained show that the presence of lime concretion layers in the sub-soil and free calcium carbonate were important factors responsible for poor growth of citrus. Fairly wide range of soil pH was found suggesting that soil pH within limits was not a controlling factor of citrus decline. Probably, the relative importance of soil pH was conditioned by other soil properties and management practices.

A nutritional trial has been in progress at Ludhiana since 1970 to find out the optimum dose of nitrogen, five levels (0, 0.75, 1.00, 1.25 and 1.5 kg N) are being tried on Musambi cv. of sweet orange at P A U, Ludhiana. Highest yield per tree (19.60 kg) was obtained under 1.25 kg N treatment but the quality of the fruit was not improved by different doses.

In a fertilizer trial on new citrus cultivars at Ludhiana, treatment $N_{150}\ P_{150}\ K_{200}$ (gm) recorded maximum number of fruits per tree in Kinnow. Treatment combinations $N_{290}\ P_{0}\ K_{150}$ (gm) recorded maximum number of fruits per tree in Wilking. In Campbell Valencia treatment combinations $N_{200}\ P_{200}\ K_{0}$ (gm) gave the maximum number of fruits per tree.

A survey was conducted to judge the mineral nutrition status of citrus orchards of Abohar area. The results indicated that nitrogen,

potassium and sulphur were found to be in satisfactory range in all the samples but phosphorus was on border line in some of the samples. The growth and yield of trees in orchards receiving good care and nutrition were good. On the other hand, growth and yield were poor in the neglected orchards and the trees were showing the decline.

A trial to find out suitable dose of N, P and K for bearing sweet orange trees of Jaffa cultivar was started in January, 1975 at Bahadurgarh (Patiala). Fertilizer doses during the second year were added in February, 1976. The treatments have not caused any significant differential effects so far.

To find out the optimum doses of N, P and K for Valencia sweet orange, a fertilizer trial is initiated at Ludhiana. Highest yield (174.3 fruits) was obtained under $N_2P_3K_2$ (N-500, P-500, K-250 gm) treatment but the fruit quality and tree growth (diameter) did not show much improvement.

To study the efficacy of herbicides on the control of weeds in Musambi sweet orange, a trial was conducted during December, 1974 at FRS, Bhatinda. All the treatments of herbicides proved ineffective in controlling the monocot weeds like Baru (Sorghum halepense) and Khabbal (Cynodon dactylon), whereas five dicot weeds out of seven were completely checked. Dry matter of both of monocot and dicot weeds was significantly reduced by the herbicidal treatments.

Kinnow fruits harvested on 19.1.76, 3.2.76, 18.2.76 and 5.3.76 were held in a cold sotrage at a temperature of 0 - 3.3°C and relative humidity 85-90% after treatment with wax emulsion (6%) and 2,4,5-T (100, 200 ppm) in polythene bags of 200 gauge. The fruits harvested on first 3 dates were stored for 100 days and those harvested on 5.3.76 for 90 days. The fruits harvested on 18.2.1976 appeared

better in appearance up to the end of storage life. The T S S increased and the acidity decreased in fruits harvested on 18.2.76 and 5.3.76 than earlier harvest.

The presence of two new citrus viruses namely "leaf curl" and "satsuma dward" was suspected. Suspected trees were further indexed and results are awaited. Tree of 43 species/cultivars were indexed for the presence of greening marker substance. Only four species/cultivars namely, Florida Rough Lemon, Amil bed, Gajanimma and Kharna Khatta were found to be free. Blood Red sweet orange budded on different rootstocks was also indexed for greening. None of the combinations was found greening-free. However, the lowest incidence of 25 per cent was recorded in Nucellar Blood Red trees raised on their own roots.

More citrus trees were surveyed around Abohar, Ludhiana and Attari. As a result, twenty-seven trees were selected and indexed for greening. Only one tree of Baramasi Nimbu and three trees of Musambi were found greening free. These were being indexed for other important citrus viruses. A total of 980 virus-free buds of different citrus species/cultivars were supplied to various research station of P A U and couple of others in the country. Swingle citrumelo, which is reported to be resistant to most of the components of dieback complex, was propagated in the screen house at Ludhiana through seeds and budwood imported from U S A.

The density population of citrus psylla and the incidence of greening disease were recorded on different citrus species/cultivars planted in R F R S, Abohar. Results revealed a positive correlation between the vector population and the incidence of greening. Psylla population recorded at three different places, viz. Ludhiana, Abohar/ jagraon and Hoshiarpur revealed that the population was markedly low at Hoshiarpur.

The extent of gramulation in citrus orchards at R F R S, Abohar was studied in different citrus cultivars/species at varying ripening periods and declining intensities of the trees. It was noted that granulation increased with approaching of harvest time and the intensity of decline. Among the rootstocks, Jatti Khatti produced maximum granulation as compared to Cleopatra, Pectinifera and Citrumelo. Jaffa amongst different sweet orange cultivars and on different rootstocks produced maximum granulation. Valencia, on the other hand, was not affected much with different rootstocks in terms of granulation.

G R A P E S

A varietal trial with ten important grape cultivars has been in progress at Abohar since March, 1966. Anab-e-Shahi continued to lead in vigour followed by Beauty Seedless, Selection-7, Khalili, etc. The cultivars Beauty Seedless, Perlette, Delight and Early Muscat sprouted earliest of all. Beauty Seedless ripened earliest of all and yielded maximum crop i.e. 18.515 kg per vine. Maximum cluster weight (325 g) was of Perlette. T S S/acid ratio was the highest (30.39) in Gold cultivar.

A survey on nutritional status was conducted on grapes in the State. The results of the petiole analyses revealed low content of nitrogen in the vineyards of high productivity. The phosphorus and potassium, however, were on the higher side. The survey thus indicated that our vineyards were being supplied with high doses of fertilizers particularly P and K.

Six pre-emergence type of weedicides were tried for the control of weeds in a grown up vineyard at P A U, Ludhiana. All the chemicals proved effective for controlling both monocot and dicot weeds. However,

Duron at 3.0 - 3.5 kg/ha, gave excellent results. None of the chemicals caused any phytotoxic effects on the vine foliage.

In the grape hybridization programme, some 1958 F_1 hybrids have been produced. During the fruiting season of 1976, 170 hybrid seedlings were evaluated. Out of the bearing plants, 5 plants of Banquabad x Himrod and 4 plants of Banquabad x Perlette were found to have soft seeds. Four plants from Banquabad x Himrod and one plant each from Banquabad x Perlette and Karachi Gulabi x Thompson Seedless were found to be practically seedless. More than a dozen hybrids were observed to be quite promising in respect of their earliness and high T S S between 20-26 per cent.

Anab-e-Shahi grapes were successfully stored up to 60 days at a temperature of 0 - 3.3°C (relative humidity 85-90%). The grape bunches kept in polythene wrappers experienced the least loss in weight and remained in good condition.

Histological studies concerning drop of flower buds, flowers and unfertilized berries were conducted. The drop was found to be associated with formation of abscission layer in the pedicel. Non-viability of pollen was another cause. In most dropped flower buds and flowers the ovules were in good condition.

M A N G O

A field trial on mango cv. Dusehri is being conducted since 1971 at P A U, Ludhiana to find out the optimum doses of N, P and K for mango nutrition. The highest yield (71.04 kg/tree) was obtained from the trees which were supplied with low levels of N, P and K (100, 100, 100 g) and the tree growth was also increased under this treatment. Another

fertilizer trial on mango (cv. Dusehri) has been in progress at Fruit Research Station, Gurdaspur. Six fertilizer doses were given. The treatment 300 g N and 30 g P_2O_5 proved better than all other treatment combinations.

A nutritional trial to see the relationship between biennial bearing and nutritional status of mango trees was started this year. The data based on leaf analyses indicated that there was no difference in P and K contents of the two cultivars, i.e. Dusehri and Langra. However, N content was found slightly lower in Langra mango leaves.

A comprehensive survey of mango orchards of Gurdaspur district was carried out to assess their nutritional status. The leaf analyses data indicated that in almost all the K samples the N, P and K content was above the standard optimum level. Both the growth and yield were very poor in orchards which were neglected and were not being given any fertilizer.

P L U M S

In a varietal-cum-fertilizer trial on plum the Fruit Research Station, Bahadurgarh, the highest trunk girth, tree height and spread were observed in Alubukhara Sharbati and the lowest in Zardalu. The greatest fruit yield (65.16 kg/tree) was obtained in Zardalu and lowest in Alubukhara Sharbati. The yield was significantly affected by different nitrogen levels. It was the highest under 75 g N and the lowest under 100 g N level.

A plum varietal trial with six cultivars of plums has been under way at Bhatinda since January, 1974. Girth as well as the canopy size of the trees were recorded maximum in case of cv. Ladakh and minimum in Kataroochak. Titron and Kataroochak were the earliest to flower and Alubukhara was last. Cv. Titron set fruits first of all. A varietal

collection of plums has also been set up to screen out suitable cultivar(s) for commercial purpose. Plants of Alucha Red were observed vigorus and that of Alucha Large Yellow slow in growth. Black Early was earliest to flower and to sprout the Kelsey Japan sprouted last of all.

A nutritional trial has been in progress at Ludhiana since 1972 to find out optimum N, P and K requirement of Titron plum. The trunk diameter and spread, but not the height of the plants was significantly affected with the NPK treatments. The trunk diameter and spread was the greatest under N_3 P_1 K_1 treatment. The fruit quality was better under lower dose of nitrogen combinations.

Out of various sub-tropical plum collected at P A U, Ludhiana, the Kala Selection 2, selected from Amritsar, has out-yielded the others. The fruits of all the cultivars are sub-acid in taste. However, these are good for jam making.

P E A C H E S

A varietal collection was started in January 1974 at F R S Bhatinda with the object to find out the most suitable cultivar(s) of peach for the commercial cultivation in the arid-irrigated region. Jewel plants had the highest trunk girth whereas it was the lowest in case of Peach Dwarf. However, canopy size was observed maximum in case of Surkha and minimum in June Gold and Peach Dwarf. Eighteen out of twenty cultivars flowered this year. A varietal trial with six cultivars of peach was laid out in January 1974. Growth in terms of girth and canopy size of the trees of all the cultivars was found on a par. Peshawari Gola was the earliest to flower and to set fruit while Flordasun was last to flower. Cv. Matchless was the earliest to sprout, whereas Sunred sprouted last of all.

In order to find out the optimum doses of N, P and K for Sharbati peach, a fertilizer trial was initiated at Ludhiana. The fruit yield (30.7 kg) significantly increased under N_2 P_1 K_2 (100, 25, 100 gm) treatment. The highest fruit weight, size, pulp/stone ratio and titratable acidity was recorded under N_3 P_1 K_2 (150, 25, 100 gm) treatment. Total soluble solids of the fruit and nutrient status in the leaves did not differ significantly under any of the treatments.

Performance of local peach cultivars has been studied at Ludhiana. Jewel has proved promising and can be recommended as a suitable table variety. It has free-stone and the trees are heavy bearers. Another cultivar showing promise in the collection block is White-Knight-2. This is quite early ripening with free-stone having white flesh colour.

P E A R S

A rootstock trial on pear has been under way since 1968 at Ludhiana to find some suitable rootstock. Smith, Leconte, Kieffer and Baghugosha cultivars have shown greater vigour on Kainth than on Patharnakh. Kieffer plants on Patharnakh gave poor growth. Scion girth in Leconte and Kieffer was the highest on Kainth and the lowest on Patharnakh.

In the varietal-cum-fertilizer trial on pear, Patharnakh gave the highest trunk girth and tree height. The highest yield per tree during 1975 was obtained in Smith (60.21 kg) and lowest in Patharnakh (24.64 kg). Application of 100 g N tree gave greatest fruit yield whereas 25 g N level gave lowest fruit yield by number.

A nutritional trial has been in progress at Ludhiana since 1972 to find out optimum N, P and K requirement of Patharnakh. The growth of pear trees was not affected by any of the N P K treatments. The greatest trunk diameter and plant height was obtained with the application

of 40 gm N + 20 gm P_2O_5 + 20 gm K_2O per year age of the plant.

Patharnakh pear fruits were successfully held in cold storage at a temperature of 0 - 3.3°C (relative humidity 85-90%) up to a period of 135 days in polythene wrappers after fungicidal treatment (0.2% Captan The spoilage and loss in weight of fruits was recorded to be the least under this treatment.

DATES

Doka of Hillawi, Medjool, Shamran and Khadrawi was boiled for 2, 4, 6, 8, 10, 14 and 18 minutes and loss of sugars by way of leaching in boiling water was determined. Loss of sugars in water was directly proportional to time of boiling. Medjool lost more sugars (19.7%) than others whereas Khadrawi the minimum (7.8%).

Thinning of Khadrawi by levelling of inflorescence at 5 cm from the tip, removal of one-third inflorescence from terminal of the inflorescence of the spadix in addition to levelling and removal of one-third berries after fruit set was compared with 'no thinning'. All thinning treatments reduced the yield and failed to advance maturity.

In a trial to initiate rooting of aerial offshoots, moss grass of saturated with water and enclosed in polyethylene gave the best resul No roots were formed when the offshoots were planted directly in the fie for even after treatment with 1000 ppm and 3000 ppm of IBA. Wooden shavings' treatment proved satisfactory but the roots were formed after about five months against three months with moss grass treatment.

GUAVA

A trial to compare the effect of different levels of N, P and fertilizer on guava cv. Allahabad Safeda was started in August, 1970 at FRS, Bahadurgarh (Patiala). Different fertilizer combinations did not

produce any significant differences for fruit yield, T S S, acidity and tree height. Trunk girth and tree spread increased under higher levels of nitrogen.

Open pollinated guava seedlings of Safeda, Sardar Guava (Lucknow 49) and Seedless growing in nursery, were screened at Ludhiana. Some 298 plants flowered during March-April,1975, whereas about 900 have flowered during April,1976.

B E R

A rootstock trial on ber has been in progress since 1968 at Ludhiana. The plant height, spread, stock and the scion girth was the highest on Z. mauritiana (globular and elongated from Dehradun) whereas on Z. mauritiana (Coimbatore) the plants were low-headed, having smooth bud-union. The plants on Z. numularia (collected from different sources) were having inverted bottleneck type of bud-union.

In the spacing cum pruning trial, the trees planted at 15' x 15' distance were significantly taller than others. They appeared also very much congested and gave poor bearing. The trees planted at 25' x 25' distance were better in all aspects of growth. The unpruned trees were more spreading. The trees in which one-fourth or one-half of the growth was retained seem to be better under pruning treatments.

P O M E G R A N A T E

A varietal collection of pomegranate has been set up to screen out suitable cultivar(s) for commercial purpose at Ludhiana. Out of 23 cultivars which have come into flowering and fruiting the variety Anar

Malas (an Iranian introduction) has given the highest average number of fruits per plant and at the same time it has the minimum number of the cracked fruits.

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T H A N K S